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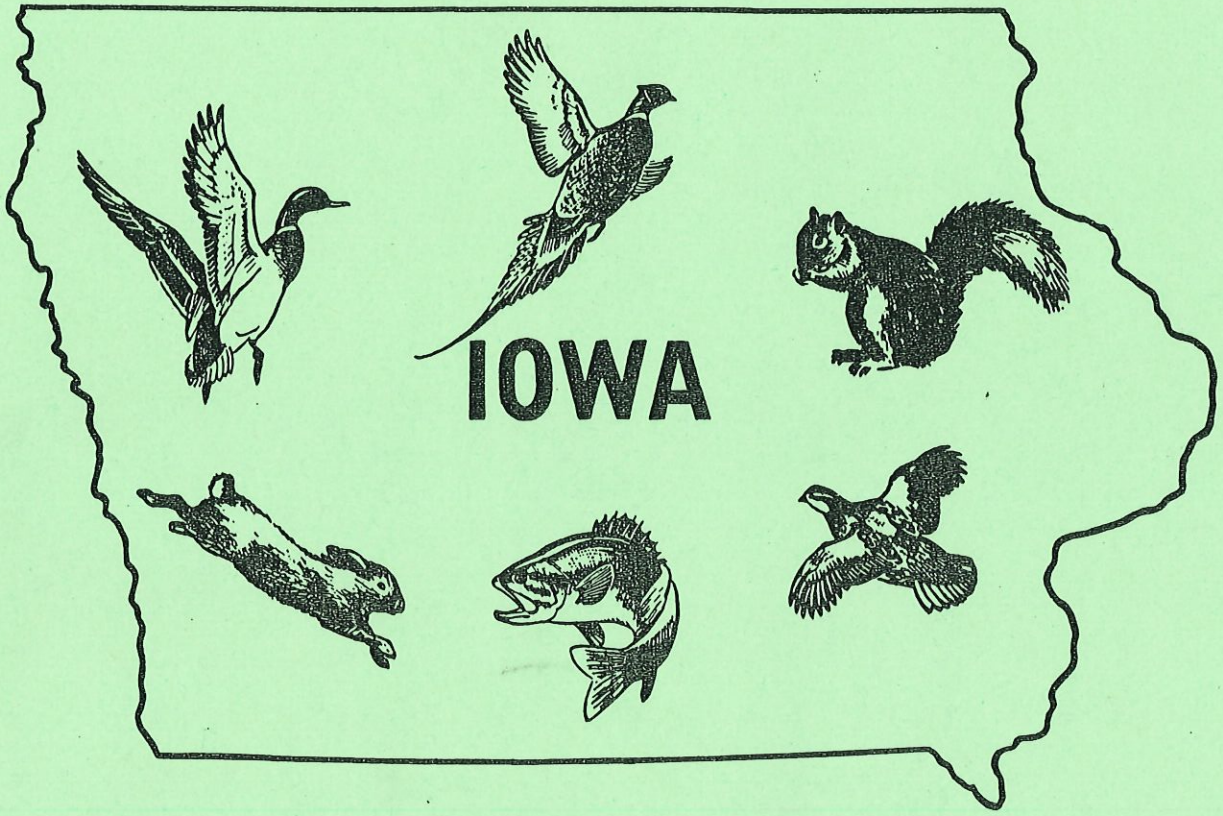
QUARTERLY BIOLOGY REPORTS



FISH AND GAME DIVISION — BIOLOGY SECTION

STATE CONSERVATION COMMISSION

QUARTERLY BIOLOGY REPORT

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1970

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AGE AND GROWTH OF YELLOW PERCH IN SPIRIT LAKE

Terry Jennings
Fisheries Biologist

During summer test netting at Spirit Lake, age and growth data was collected from yellow perch. This study was part of a project to record age and growth data from all major species of fish in Spirit Lake. In 1968, 277 lengths and weights were recorded. The length-weight relationship is best described by the equation $Log_{10}W = -3.2789 + 3.0239\ Log_{10}L$. During 1967 and 1968, 396 scale samples were aged. The body-scale relationship was computed to be $L = 0.66 + 1.59\ R$. Growth was rapid with estimated body lengths of 3.0, 6.7, 9.0, 10.1, 10.7, 11.2, and 11.9 inches at each respective annulus. No fish older than seven years were observed.

ESTIMATES OF BIOMASS OF BIGMOUTH BUFFALO IN CORALVILLE RESERVOIR

Larry Mitzner
Fisheries Biologist

Discussion is given on parameters contributing to the determination of biomass of bigmouth buffalo. The distribution of estimated biomass was 117, 134, 115, 85, 56, 37, 25, 15 and 10 lbs. per acre for age groups II through X. Sum of age groups yielded 594 pounds per acre, the largest population by weight in the reservoir. Critical size was 14.8 inches.

CATCH SUCCESS OF COMMERCIAL FISH SPECIES DURING TWELVE BI- WEEKLY NETTING PERIODS IN RED ROCK RESERVOIR, 1970

Gaige Wunder
Fisheries Biologist

During 12 bi-weekly periods of intensive netting at Red Rock Reservoir, three principal species of fish with commercial or industrial value were exploited to simulate a limited commercial fishery. Carp, carpsucker and buffalofish were removed at an unlimited rate totaling 117,253 fish weighing 52,912.1 lbs. Catch success of these species varied over the 12 periods from 2.2 to 618.0 FND. Mean weight for the combined fish was 0.44 lbs.

COMMERCIAL FISHERMEN'S REACTIONS TO A PROPOSED 15-INCH COMMERCIAL CATFISH SIZE LIMIT

Don R. Helms
Fisheries Biologist

A questionnaire distributed to 175 Iowa commercial fishermen reporting a significant catfish harvest disclosed that 34% approved changing the size limit on catfish from 13 to 15 inches. Fifty-three percent opposed the change, while 13% were undecided. Four alternative changes met with similar disapproval, and the majority wanted no change from present regulations.

AN ANNOTATED LIST OF FISHES OF THE SOLDIER RIVER DRAINAGE

Don Kline
Fisheries Biologist

This study of the fish distribution in the Soldier River contains notes on 13 species of fish and 6 families and continues the inventory set up by Meek and Harrison. Fishes were sampled using seine and Rotenone. Gizzard Shad, River Carpsucker, Sand Shiner, Emerald Shiner, Plains Suckermouth Minnow and White Bass were added to the list of species found in the Soldier River. A description is given of each station and the fish are listed with notes on their distribution, numbers, length and previous records.

GAME

GIANT CANADA GOOSE RESTORATION PROJECT

Richard Bishop
Waterfowl Biologist
and
Ronald G. Howing
Unit Game Manager

Giant Canada geese (Branta canadensis maxima) were common nesters in Iowa prior to 1900. Due to over exploitation, most wild nesting geese were exterminated in Iowa by 1900. Recent efforts by the Iowa Conservation Commission to re-establish these birds have been successful. Management of this flock has increased it from a few pair in 1964 to 800 - 1,000 birds in 1970. This was accomplished mainly by providing protection and nesting areas. These birds have adapted to the surrounding habitat and established a migration tradition. Through continued management, it is the goal to increase this flock to 6,000 birds.

A NEW DEER CENSUS TECHNIQUE FOR IOWA

Lee Gladfelter
Game Biologist

A new census technique for Iowa will be tested during the winter of 1970-71. This technique is a track count of deer crossing prescribed census routes. These census routes will be set up on roads bordering good deer habitat. Observers will count deer tracks and a statewide average will be determined and compared with following years. These counts will be conducted in the winter after fresh snowfalls. Other information will be obtained from the track counts, such as movement of deer in relation to weather conditions. If the track counts prove feasible after the first winter, the routes will be expanded in number to include all areas of the state.

IOWA'S LATE SUMMER PHEASANT POPULATION - 1970

Richard C. Nomsen
Game Biologist

The August roadside pheasant count is the primary source of information on the status of the pre-hunting season pheasant population. There were 182 routes checked by Conservation Officers, Game Section personnel and Biologists in 1970. Although the winter of 1969-1970 was long and cold, it lacked severe storms so pheasant mortality was below normal. A very warm April-May period prompted early nesting activity. Reproductive success was excellent in all regions of Iowa's pheasant range. Observers recorded an average of 2.24 birds per mile which was 47% higher than in 1969. The number of broods sighted increased 44%.

RESULTS OF 1970 RABBIT SURVEYS IN IOWA

Gene Hlavka
Game Biologist

The July rabbit survey was conducted for the 21st consecutive year. Ninety-four routes were surveyed in 1970. This survey indicated a gain in the cottontail population of 11% from that of last year, but it was still 7% below the 20-year average. Two other surveys also indicated increases in cottontail populations. The fall population index showed a 14% increase in the cottontail rate of reproduction. Winter and spring weather of 1970 was unusually favorable for rabbits.

IOWA QUAIL POPULATION, 1970

M. E. Stempel
Game Biologist

The 1970 spring season was favorable for quail production. As a result, the population present in the fall was at a high level, similar to the pattern of recent years. The 1969-70 winter in the primary quail range was also favorable, meaning that the birds were in prime condition going into the breeding season. As a result of the better than average conditions during 1970, hunters should experience a good quail season this fall.

FOX MOVEMENT STUDIES

Ron Andrews
Game Biologist

In order to properly manage and assess the red fox (Vulpes fulva) as a game animal, a fur bearer and a predator in Iowa, it is necessary that we have a current knowledge of its population status, productivity, movements, mortality, and food habits. In 1966, a fox ear-tagging study was initiated to determine the movement and mortality of Iowa red fox. This year, 1970, marked the fifth and final year of the fox tagging project. This paper reviews the technique involved and assesses the sex ratios and litter sizes of the foxes tagged during the 5-year study. A brief discussion on fox mortality is also presented. Some possible applications of the data gained are also briefly mentioned.

IOWA'S 1970 MAST SURVEY

Bob Sheets
Game Biologist

Results of the 1970 mast survey have been completed. This year's statewide index of 1.9 represents a favorable increase over last year's index of 1.6. Black walnut and most oaks produced better this year while shagbark hickory, bitternut hickory and butternut produced a lower mast crop than last year. A comparison of survey results between District Foresters and Game Unit Managers is made.

AGE AND GROWTH OF YELLOW PERCH IN SPIRIT LAKE

Terry Jennings
Fisheries Biologist

Research on fish population at Spirit Lake has been conducted periodically for more than 20 years. Most of it, however, has been related to walleye. Nothing has been written on many important fishes including yellow perch (Perca flavescens). In 1967, a study was initiated to investigate the life history, with particular reference to rate of growth, of the "neglected" species.

The principle objective of this paper is to record the rate of growth of yellow perch in Spirit Lake. These data were collected in 1967 and 1968 from fish captured during summer test netting.

Spirit Lake is located in northwest Iowa. Physical features of the lake basin have been described in previous Quarterly Biology Reports.

Length-Weight Relationship

In 1968, 277 measurements of length and weight were recorded. As a matter of standard procedure, lengths were recorded to the nearest one-tenth of an inch and weights were recorded to the nearest one-hundredth of a pound. These data were divided into 1.0 inch length intervals and mean values plotted on Figure 1. The least squares procedure was used to compute the equation:

$$\text{Log } W = -3.2789 + 3.0239 \text{ Log } L$$

Observed and calculated weights (Table 1) were not significantly different ($P \geq 0.05$). Maximum deviation between observed and empirical weights was 0.03 lbs.

Body-Scale Relationship

During 1967 and 1968, 396 scale samples were aged . All scales were taken from the fishes left side 2 to 4 scale rows below the lateral line and below the origin of the dorsal fin. Aging was accompanied using a micro-projector and 32 power magnification.

The sample was divided into 1.0 inch length intervals. Mean total length and mean scale radius of each interval were plotted on Figure 2. A straight line was fitted to these plots by using the equation $L = 0.66 + 1.59\ R$. A base line at .66 on a straight line nomograph was used to estimate total length at each annulus.

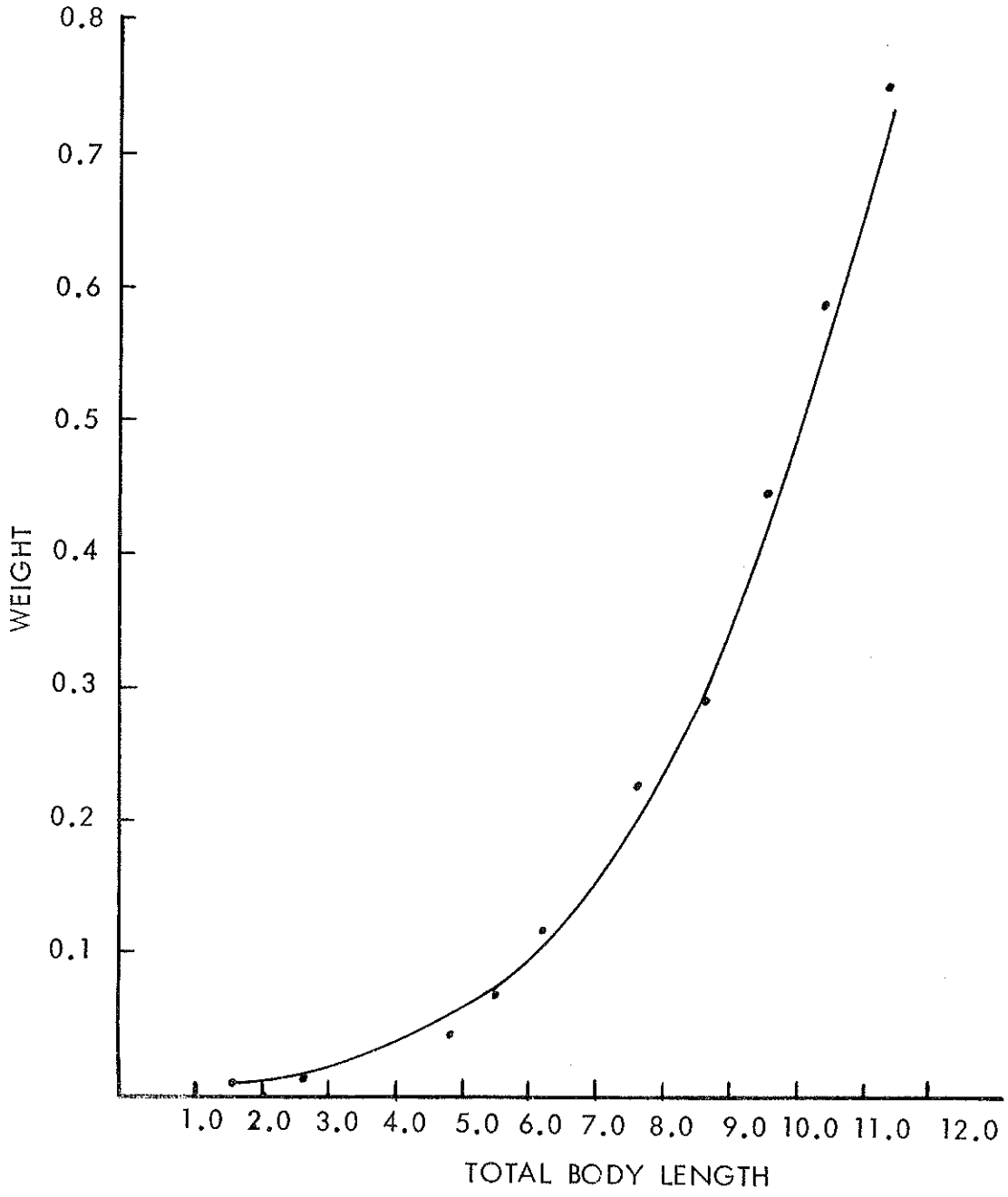

Figure 1. Length-weight relationship for Yellow Perch from Spirit Lake, 1968.

Table 1. Observed and calculated weights of yellow perch from Spirit Lake, 1968

Length Group	Mean Length	C	Mean Weight Observed	Calculated	Difference
1.0-1.9	1.5	59	0.002	0.002	0
2.0-2.9	2.6	46	0.008	0.009	0.001
4.0-4.9	4.7	39	0.04	0.05	0.01
5.0-5.9	5.5	42	0.07	0.08	0.01
6.0-6.9	6.2	50	0.12	0.12	0
7.0-7.9	7.6	52	0.23	0.22	-0.01
8.0-8.9	8.3	51	0.29	0.28	-0.01
9.0-9.9	9.6	51	0.45	0.44	-0.01
10.0-10.9	10.4	52	0.59	0.56	-0.03
11.0-11.9	11.4	51	0.75	0.73	-0.02

Rate of Growth

It is evident from Table 2 that the life span of yellow perch is relatively short. Seven years was the oldest perch observed. Rate of growth was excellent.

Table 2. Calculated lengths of yellow perch from Spirit Lake, 1967 and 1968

Age Group	Number in Sample	Mean Length at Capture	1	2	3	4	5	6	7
I	78	5.3	3.1						
II	82	7.8	2.9	6.3					
III	77	9.7	2.8	6.5	8.9				
IV	73	10.6	3.0	6.6	9.0	10.1			
V	54	11.1	3.1	7.0	9.1	10.0	10.7		
VI	30	11.4	3.1	7.4	9.3	10.2	10.8	11.2	
VII	2	12.2	3.3	8.0	9.9	10.5	11.1	11.5	11.9
Grand average calculated lengths			3.0	6.7	9.0	10.1	10.7	11.2	11.9
Increments of grand average			3.0	3.7	2.3	1.1	0.6	0.5	0.7

Estimated total lengths in inches at annuli 1 through 7 are 3.0, 6.7, 9.0, 10.1, 10.7, 11.2, and 11.9. Average annual growth increments in inches are 3.0, 3.7, 2.3, 1.1, 0.6, 0.5, and 0.7, respectively. Growth was fastest during the second year of life.

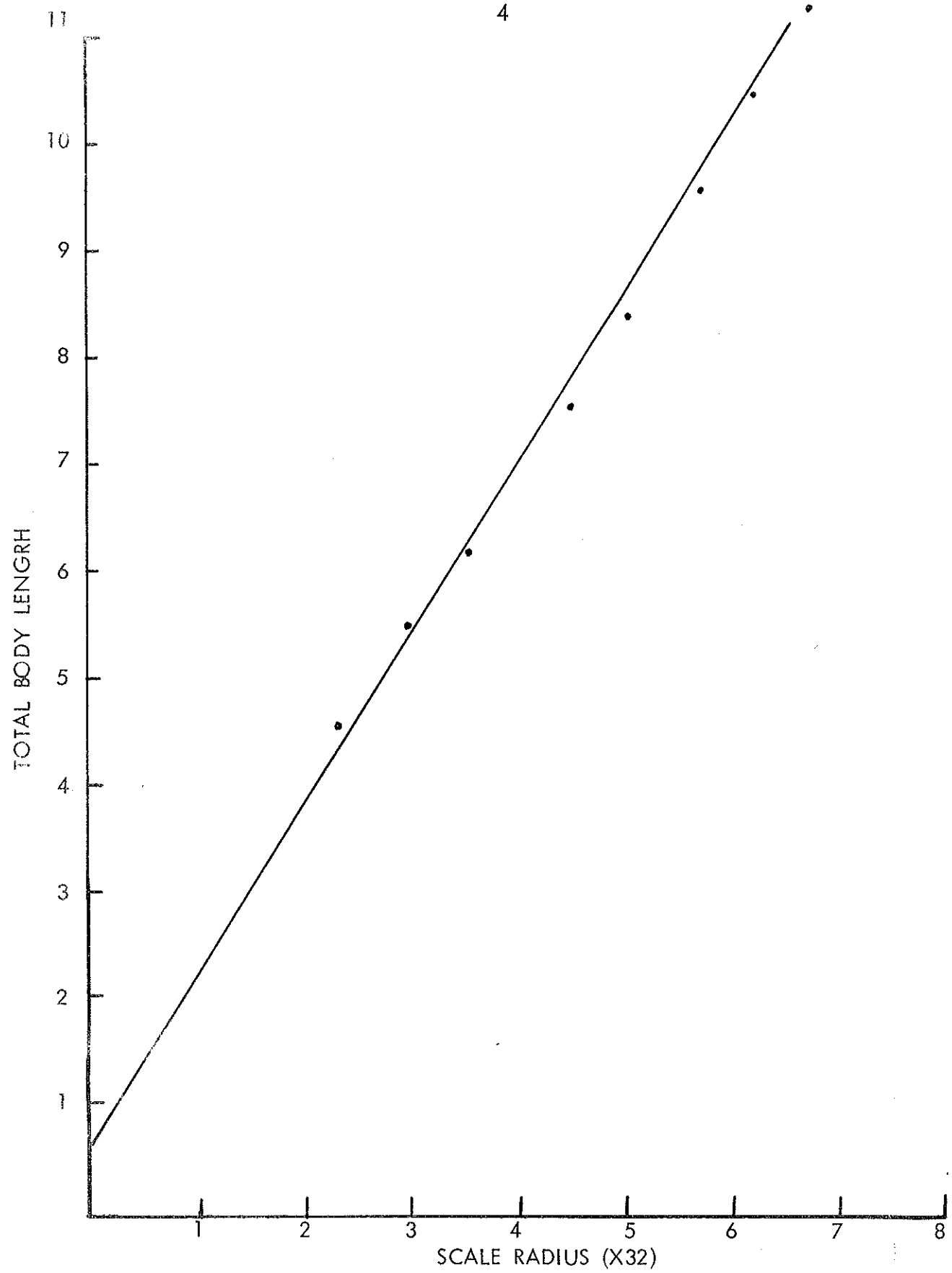

Figure 2. Body-scale relationship for yellow perch from Spirit Lake, 1968.

The rate of growth observed for Spirit Lake perch is much faster than the growth of perch in Lake West Okoboji. Data collected in 1963 indicates West Okoboji perch were 2.1, 5.0, 7.2, 8.5, 9.6, and 10.4 inches total length at each respective annulus (Jennings and Moen, 1964). Six year old West Okoboji perch were about the same length as four year old Spirit Lake perch.

Summary

The length-weight relationship can best be described by the equation Log W = -3.2789 + 3.0239 Log L.

The body-scale relationship was straight line with an a value of .66 and b value of 1.59.

Total estimated length at each annulus was 3.0, 6.7, 9.0, 10.1, 10.7, 11.2, and 11.9 inches respectively.

Rate of growth was fastest the second year of life.

No perch older than seven years was observed.

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Jennings, T. and T. Moen.
1964. Yellow perch, Perca flavescens, in West Okoboji Lake, with special reference to the 1960 year class. Quarterly Biology Reports 16 (3): 1-3.

ESTIMATES OF BIOMASS OF BIGMOUTH BUFFALO IN CORALVILLE RESERVOIR

Larry Mitzner
Fisheries Biologist

The objective of a commercial fishery is to produce a maximum yield in weight, not necessarily numbers, of marketable size fish. A year class of fish decreases numerically at some rate from hatching, but is offset by an increase in weight at a given rate. Net growth in weight of a year class is related to growth in length, length-weight relationship and mortality rate. The biomass of a fish population is the sum of the growth in weight of all year classes present at a given time.

Critical or optimum size is achieved when biomass starts to decrease or when growth in weight is overcome by total mortality. For greatest efficiency of harvest, fish should be cropped at or slightly before critical size is reached. The knowledge of critical size of fish populations would aid in determining possible minimum size limits or minimum mesh size restrictions if this is necessary or desirable. Once size limits or mesh size have been established, then type of gear can be chosen and the maximum intensity for that gear can be established. The scope of this presentation is only to establish biomass estimates and critical size of bigmouth buffalo. Consideration to possible gear use and maximum equilibrium yield will be presented in future reports.

Parameters of growth in length, length-weight relationship, mortality and density of bigmouth buffalo will be reported on in detail by Mayhew and Mitzner (in press). Summary of these parameters are listed in Table 1. Mean growth in weight was established by multiplying length for a given age by the mean weight at that length as determined from length-weight relationship. Average number of fish per acre at each age group was determined by portioning the total population estimate per acre by the average mortality rate. The biomass was then derived by the sum of products between mean weight and mean number per acre at all ages.

There was some doubt as to bigmouth buffalo population estimates and mortality rate. For this reason the lower population estimate, 281 per acre, at 95% confidence and the upper mortality rate, 0.45, at 95% confidence were used to determine density for each age group.

Table 1. Distribution of estimated biomass of bigmouth buffalo

Age	Average length	Average weight	Density per acre	Pounds per acre
II	11.7	0.90	130	117
III	15.0	1.92	70	134
IV	17.4	3.02	38	115

Table 1. continued

V	19.3	4.25	20	85
VI	20.8	5.12	11	56
VII	22.3	6.35	6	37
VIII	23.8	7.74	3	25
IX	24.9	8.94	2	15
X	27.7	12.31	1	10
TOTAL			281	594

Age groups II-X had mean densities of 130, 70, 38, 20, 11, 6, 3, 2 and 1 per acre. Mean weights for these ages based on 1969 length-weight relationship were 0.90, 1.92, 3.02, 4.15, 5.12, 6.35, 7.74, 8.94 and 12.31 lbs (Table 1). Biomass of each age group yielded 594 lbs per acre. Critical size occurred at age 2.9 or 14.8 inches. Fish of this size have a mean weight of 1.8 lbs.

Of the commercially valuable fish species in Coralville Reservoir, bigmouth buffalo has the greatest potential. Carp, channel catfish and carpsucker also have value and could be harvested. Channel catfish would demand the highest monetary value per pound, but harvest would be low because their estimated biomass, 3.8 lbs per acre, is extremely low. If market price differences between bigmouth buffalo and channel catfish were taken into consideration, bigmouth buffalo would still be more valuable because of their extremely large estimated biomass of 594 lbs per acre.

It is too soon to ascertain which fish populations will dominate in newer flood control reservoir, but if Coralville is an indication of what may occur, then bigmouth buffalo will occupy a major volume of the species composition in these reservoirs. Furthermore, these populations will be completely unutilized by the sport angler. Harvest of commercial species in Iowa reservoirs at this time should presuppose that sport fish populations remain unaltered and high priority be given to possible management of bigmouth buffalo on a commercial basis.

Literature Cited

Mayhew, J. and L. Mitzner
1970. Report on the fourth year study of commercial fish species in Red Rock and Coralville Reservoirs. Biology Section, Commercial Fisheries Report, Project 4-11-R-4, Iowa Cons. Comm.

CATCH SUCCESS OF COMMERCIAL FISH SPECIES DURING TWELVE BI-WEEKLY NETTING PERIODS IN RED ROCK RESERVOIR, 1970

Gaige Wunder
Fisheries Biologist

Red Rock Reservoir, the principal flood control impoundment on the Des Moines River, is located approximately 50 miles below the city of Des Moines. It was impounded in the spring of 1969.

During 1969, reservoir water levels fluctuated extensively and had a pronounced effect on the fish population (Wunder, 1969). Many species exhibited rapid increases in abundance and growth. By the end of the season, the fish population was estimated at more than 150 obs per surface acre.

Water levels during 1970 were stable with a maximum fluctuation of 10 ft occurring over a one week period in late spring. Other minor changes occurred during periods of heavy rainfall, but water levels returned to conservation pool in less than one week.

Methods and Procedures

One inch bar measure pound nets similar to those used in the 1969 fishery were set for a five-day week. They were lifted each day and removed over the weekend. Data were collected during 12 of 15 bi-weekly periods from 15 March to 10 October. Similarly, numbered bi-weekly periods were used in 1969.

All fish sampled were seperated by species, counted and weighed in aggregate. Accessory data such as scale samples and length frequency were also collected to assist in analysis of the fishery. Fish with commercial or industrial value such as carp, carpsucker and buffalofish were experimentally exploited to determine the effect of removal efforts upon fish population dynamics. All other species were released.

Results

During 12 bi-weekly periods of 451 net days, 117,253 fish weighing 52,012.1 lbs were captured (Table 1). Carp comprised 59.5% of the catch followed by carpsucker and buffalofish with 26.5% and 14.0%, respectively.

Table 1. Catch statistics of three commercial fish species in twelve bi-weekly periods in Red Rock Reservoir, 1970

Species	Total Number	% Number	Total Weight	% Weight	Weight
Carp	69,734	59.5	23,070.3	44.4	.33
Carpsucker	31,128	26.5	20,450.9	39.3	.65
Buffalofish	16,391	14.0	8,490.9	16.3	.51
Total	117,253		52,012.1		.44

Carp, carpsucker and buffalofish contributed 44.4%, 39.3% and 16.3% by weight to the catch.

Catch success fluctuations in fish per net day (FND) for the three species (Figure 1). Catch success for carp ranged from 51.0 FND in Period 10 to 618.0 FND in Period 2 with a mean of 154.6 FND. Carpsucker ranged from 2.5 FND in Period 4 to 174.2 FND in Period 9 with a mean of 69.0 FND. Buffalofish ranged from 2.2 FND in Period 4 to 69.7 FND in Period 8 with a mean of 36.3 FND (Table 2).

Mean weight remained relatively stable over the entire netting season indicating little recruitment of young of the year fish into the population vulnerable to the pound net (Figure 2).

Table 2. Catch success and mean weight of three commercial fish species for twelve bi-weekly netting periods in Red Rock Reservoir, 1970

Species	2	3	4	6	7	8	9	10	11	12	13	15
Carp												
FND	618.0	138.7	159.6	191.3	174.6	165.1	173.5	51.0	142.9	243.9	541.2	119.9
$\bar{X}$ wgt	.21	.56	.51	.26	.42	.35	.36	.40	.38	.14	.48	.41
Carpsucker												
FND	8.5	22.5	2.5	52.4	72.2	60.6	174.2	108.7	43.5	51.0	69.6	40.2
$\bar{X}$ wgt	.57	.87	.67	.45	.55	.61	.62	.73	.47	.78	.73	.62
Buffalofish												
FND	52.1	57.8	2.2	54.8	26.2	69.7	63.1	33.2	27.7	17.8	52.3	17.2
$\bar{X}$ wgt	.32	.47	.80	.35	.54	.58	.52	.49	.49	.54	.57	.58

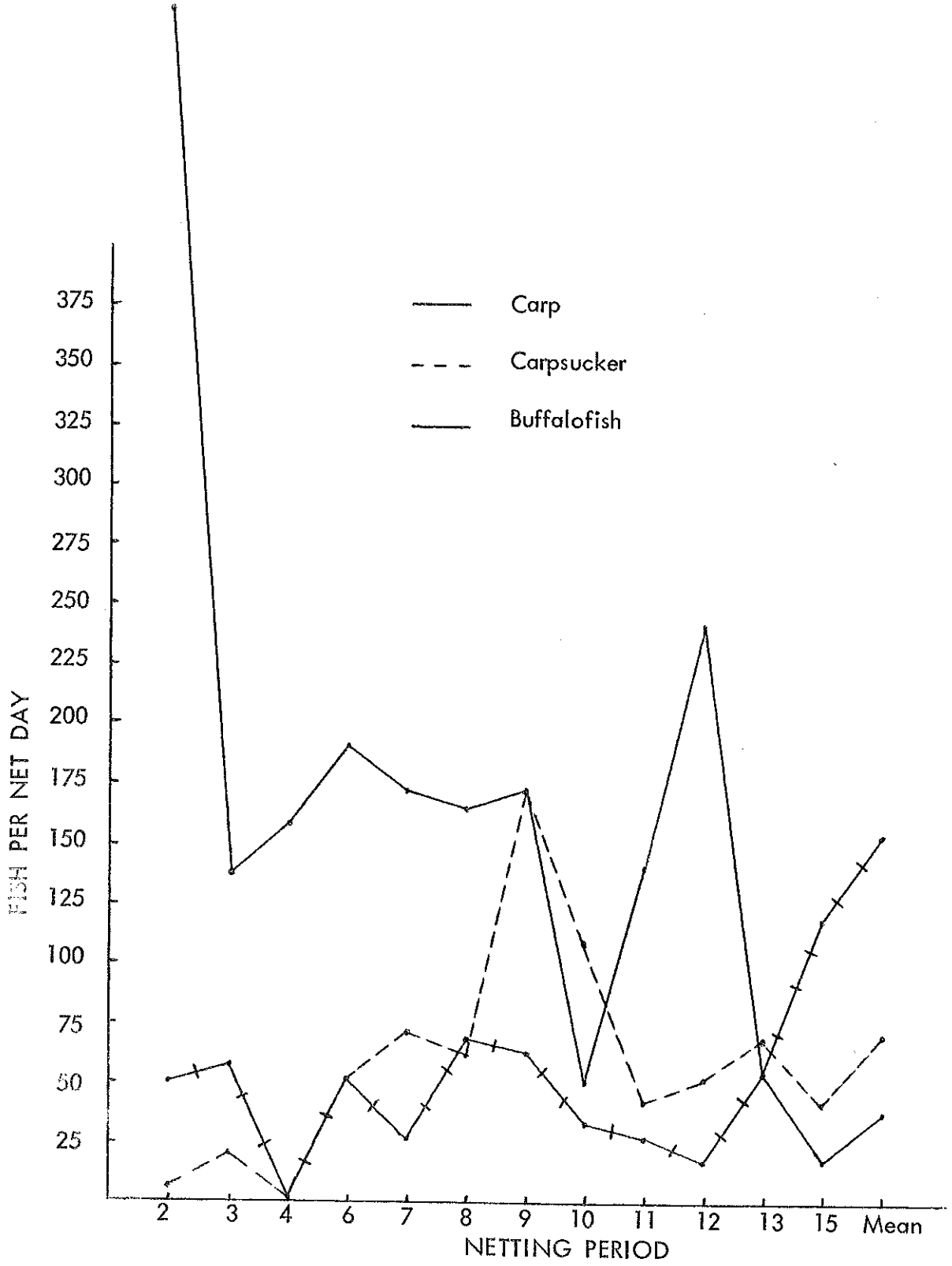

Figure 1. Catch success in FND for three commercial fish species in Red Rock Reservoir, 1970.

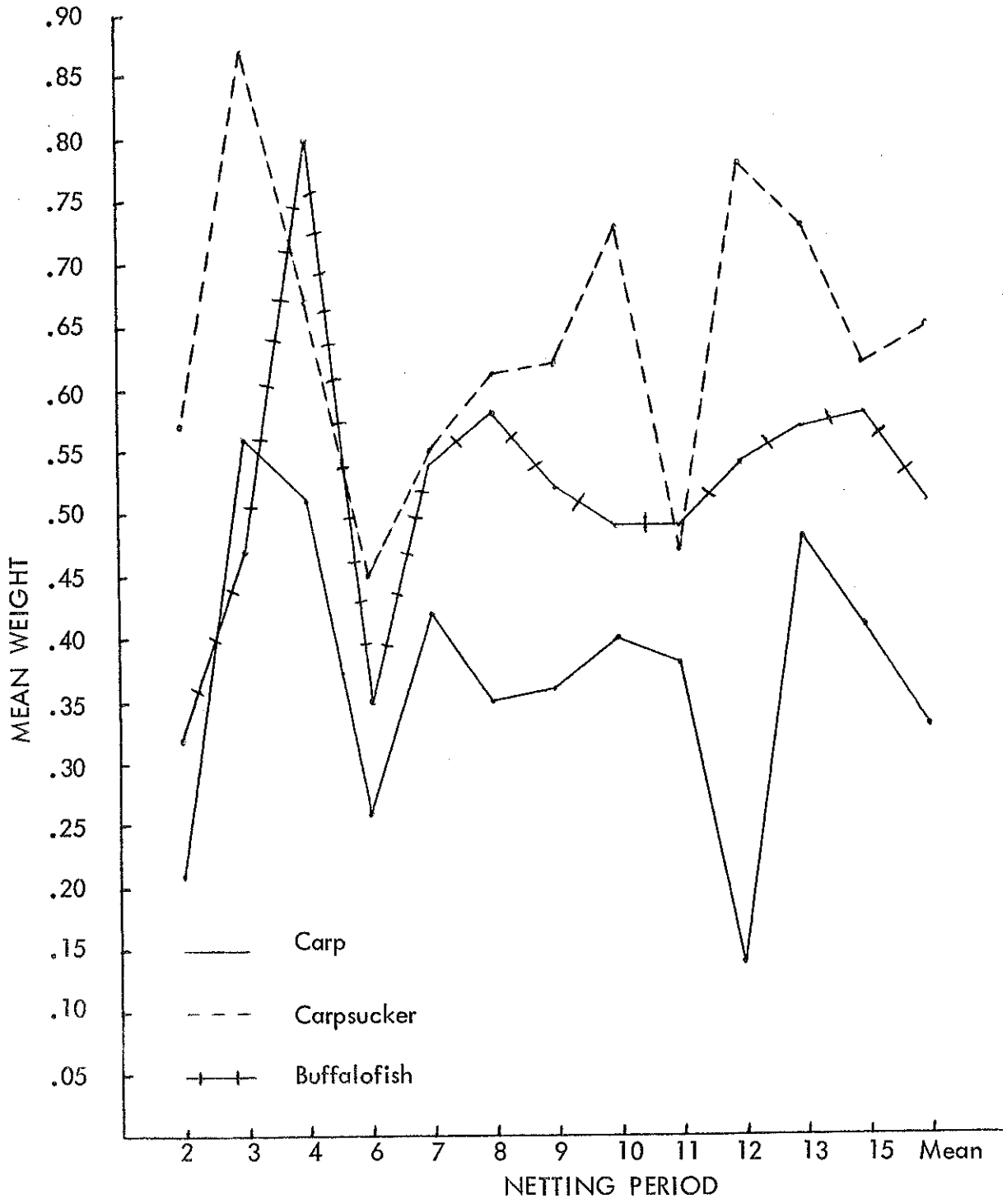

Figure 2. Mean weight for three commercial fish species in Red Rock Reservoir, 1970

Discussion

To be of value in a commercial fishery enterprise fish must be large enough to attain some market value. Species of the size and mean weight sampled in this fishery, carp (0.33 lbs), carpsucker (0.65) and buffalofish (0.51 lbs), have little value and would be extremely difficult to dispose of in a commercial market. Likewise, fishing effort and expense per pound harvested were high and would become the limiting factor for any commercial netting operation.

In addition, low water levels in the reservoir limited the amount of food available for some fish, particularly the commercial species sampled here. An abundance of small fish along with a slower growth rate combine to reduce the appeal of these fish from a commercial standpoint.

Literature Cited

Wunder, G.
1969. Red Rock Reservoir Investigations, 1969. Quarterly Biology Report, Vol. XXI, No. 3, pp 5-9.

COMMERCIAL FISHERMEN'S REACTIONS TO A PROPOSED 15-INCH COMMERCIAL CATFISH SIZE LIMIT

Don R. Helms
Fisheries Biologist

As the result of several years studies on the Mississippi River, recommendations have been made to reduce channel catfish over-exploitation from commercial fishing by raising the size limit from 13 to 15 inches. The Fish Technical Section presented this proposal to the UMRCC in January 1970. Although it was approved unanimously, Iowa's affirmative vote was qualified by a desire to inform commercial fishermen of its purpose and try to gain their approval.

In accordance, a report explaining the need for changing the size limit to 15-inches and expected results was distributed to licensed commercial fishermen. A questionnaire was distributed to those fishermen reporting significant catfish harvest. The purpose of the questionnaire was to determine their reaction to the proposed size limit change and various alternatives.

Method

The questionnaire (Appendix) was mailed to 175 fishermen selected from commercial fishing reports. These included those who reported in excess of 500 lbs of catfish during 1968 or 1969.

The first page of the questionnaire delt with background data and provided space for name, pool fished, amount and type of gear fished, years of fishing experience, weight of harvest, whether or not they dressed their fish, price received, outlet and whether or not they fished primarily for catfish. In addition, four statements were presented which could be checked if the fisherman agreed with them. These concerned whether they felt fishing was improving, getting worse, fluctuating from year to year with no overall change and whether they thought there was a problem with catfish in their pool.

The next segment of the questionnaire delt with the 15-inch size limit proposal and five alternatives. Alternatives included close the season during spawning, close basket fishing, close the season periodically, increase mesh size in nets and holes in baskets, and make no change in the present regulations. The fishermen were asked to check whether they approved, disapproved, or were undecided about each statement. Space was also provided for comments and suggestions.

Initial response to the questionnaire was poor. Thirty days after mailing, only 25% had replied. Those who had not replied were contacted personally and urged to complete and return the questionnaire. Final return was thus brought to 53.7%.

Results

Preliminary Information

Tabulation of the preliminary information is presented in Table 1. Replies are thought to be representative of the fishermen and numbers returned from each pool are generally in proportion to the number contacted.

Reporting fishermen averaged 23.7 years of fishing experience and report an average annual harvest of 3,378 lbs of catfish. Fifty (56%) indicated they dress most of their fish before marketing and receive an average of 67.0 cents per lb. Forty (44%) said they sell their fish whole and average 32.2 cents per lb. Only 10 fishermen indicated they ship the bulk of their catfish to Chicago, while 57 sell to local fish markets and 25 have other outlets including restaurants, groceries, their own markets, etc. Forty-eight (51%) indicated they fish primarily for catfish.

Condition of the Fishery

Reaction to the statements on condition of the fishery varied considerably from pool to pool (Table 2). In the lower pools, a high percentage of fishermen indicated fishing was getting worse. However, Pool 9 was the opposite. Several fishermen indicated fishing was improving for there was no problem. In Pool 10, most indicated fishing was getting worse. Such contrasting responses are difficult to interpret because of a number of variables. For example, short term fluctuations cause bias by being interpreted differently by fishermen who have only been fishing a short time compared to fishermen having much experience. This is demonstrated in Table 3 where the answers are catagorized by years of fishing experience.

Reaction to Size Limit Proposal

Reaction to the proposed change in size limit was generally one of disfavor in most pools (Table 4). A significant number (34.4%) approved. About half (52.7%) were against it while the remaining 12.9% were undecided.

Comments of disapproval were generally centered around a concern for the loss of the much demanded "individual" sized fish. Fear was expressed that elimination of small fish from their harvest would result in an overall cut in market value and promote the substitution of farm reared fish from the south. The latter was of particular concern to fishermen in the lower pools.

Alternatives to Changing the Size Limit

Reaction to alternative changes in regulations were similar to changing the size limit (Tables 5 through 8). None met majority approval. Closing the season during spawning drew the least resistence. The majority wanted no change in the present regulations (Table 9).

Comments and Suggestions

Comments and suggestions were many and varied. Pollution was by far the most common topic and much concern was expressed about the degrading conditions brought on by industrial and municipal discharges, pesticides, and barge spills and dumpings.

Another topic of concern to many fishermen was the abuse and misuse of commercial gear by the sport fishermen or "weekender". Comments here were mostly directed to their inability and laxity in caring for the gear properly. Baskets cause injury to the fish and must be tended regularly, particularly during the spawning season and warmer months. Sport fishermen generally tend toward checking their baskets only once a week or tend them for a while and then loose interest and forget them. Sport fishermen frequently do not mark the location of their tackle well enough and loose it. A lost trap continues to fish for years and causes much waste.

It appears to the author that much of this could be eliminated by requiring the single basket fisherman to attach a float to his basket labled with name and address as he is now required with trot lines. I would highly recommend this.

Another frequently mentioned complaint was abuse of operator certificates and tags. Some wanted to raise the commercial license to $50, $100 or even $300 and give free tags while others simply wanted all fishermen charged the same $15 fee and eliminate the operator certificate. I would recommend this be given consideration as the operator certificate is certainly abused in its present status.

Other comments and suggestions included pleas for the states of Iowa and Illinois to stop removing catfish for stocking elsewhere, putting limits on quantity of gear individuals can license, stop winter fishing with hoop nets and baskets, stricter enforcement on unlicensed gear, keep the 13-inch size limit and require that large fish be returned, raise the limit to 14-inches rather than 15-inches, have officers patrol in "plain clothes" so they can catch people with short catfish, and open a commercial season on certain game fish.

Summary

Population studies have indicated over-exploitation of channel catfish in the Mississippi River. Further, it has been deemed biologically sound to improve the population structure and increase catfish production by raising the commercial size limit from 13 to 15-inches. It was the purpose of this paper to present additional information toward this end.

Table 1. Preliminary information tabulated by area fishes

Pool	N Contacted	% Returned	Years Fishing Experience	Mean Annual Harvest (lbs)	N Dressing Fish		Mean Price Obtained		Outlet for Fish			Number Fishing Primarily For Catfish
					Yes	No	Dressed	Whole	Ship to Chicago	Local Fish Markets	Other	
9	21	66.7	26.5	5,038	2	10	57.5	27.8	0	8	1	5
10	12	75.0	22.3	1,706	8	1	64.0	35.0	3	1	5	2
11	19	47.4	24.7	4,306	6	0	58.3	----	2	5	1	3
12	7	42.9	31.5	3,767	2	0	67.5	35.0	1	1	2	1
13	21	66.7	18.2	2,175	6	8	66.8	35.0	2	12	3	8
14	18	55.6	25.7	5,149	8	2	71.9	35.0	0	5	4	6
15	2	0.0										
16	8	37.5	17.7	667	2	1	72.5	30.0	0	2	1	2
17	12	33.3	26.8	2,575	2	2	67.5	32.5	0	3	1	3
18	18	61.1	20.8	5,125	7	6	71.4	32.8	1	7	3	8
19	37	45.9	26.2	1,915	7	10	68.8	33.2	1	13	4	10
TOTAL	175	53.7	23.7	3,378	50	40	67.0	32.2	10	57	25	48

Table 2. Fishermen's reactions to statements about status of the fishery by area fished

STATEMENT	NUMBER OF RESPONSES BY POOL											
	9	10	11	12	13	14	15	16	17	18	19	TOTAL
A. Fishing for catfish in this pool is improving.	4	1	1	0	3	0	--	0	0	2	4	15
B. Fishing for catfish in this pool is getting worse.	3	4	3	1	6	3	--	2	3	5	8	38
C. Catfishing in this pool has good years and bad years with no overall change.	7	4	5	1	6	7	--	1	1	3	7	42
D. I see no problem with catfish in this pool.	7	2	4	0	6	2	—	0	0	2	3	26

Table 3. Fishermen's reactions to statements about status of the fishery categorized by years fishing experience and harvest

	Years Experience					Harvest (lbs per year)		
	0 to 5	6 to 10	11 to 15	16 to 20	over 20	500 to 1,000	1,000 to 5,000	over 5,000
A. Fishing for catfish in this pool is improving.	0	2	1	4	9	4	8	4
B. Fishing for catfish in this pool is getting worse.	8	8	4	4	14	14	19	6
C. Catfishing in this pool has good years and bad years with no overall change.	1	7	1	9	29	13	23	7
D. I see no problem with catfish in this pool.	0	2	0	7	16	6	13	7

Table 4. Fisherman reaction to the 15-inch size limit proposal by area fished

	POOL												
	9	10	11	12	13	14	15	16	17	18	19	TOTAL	PERCENT
Approved	2	2	6	3	12	1	--	1	0	2	3	32	34.4
Disapproved	9	5	2	0	2	9	--	1	2	9	10	49	52.7
Undecided	3	2	0	0	1	0	--	1	2	0	3	12	12.9

Table 5. Fisherman reaction to the alternative of closing the season during the spawning run

	POOL												
	9	10	11	12	13	14	15	16	17	18	19	TOTAL	PERCENT
Approved	2	0	5	2	8	4	--	1	1	6	8	37	39.4
Disapproved	9	5	4	0	6	3	--	2	3	4	8	44	46.8
Undecided	3	4	0	1	1	2	--	0	0	1	1	13	13.8

Table 6. Fisherman reaction to the alternative of closing the season to basket fishing for both sport and commercial use

	POOL												
	9	10	11	12	13	14	15	16	17	18	19	TOTAL	PERCENT
Approved	0	2	5	0	5	2	--	0	1	4	7	25	27.2
Disapproved	12	4	4	0	4	11	--	2	3	7	6	54	58.7
Undecided	2	3	--	1	1	1	--	1	0	0	4	13	14.1

Table 7. Fisherman reaction to the alternative of closing the season periodically as necessary to permit the population to recover

	POOL												
	9	10	11	12	13	14	15	16	17	18	19	TOTAL	PERCENT
Approved	0	2	0	0	4	0	--	1	1	4	3	15	16.3
Disapproved	13	5	7	1	10	9	--	2	3	6	10	66	71.7
Undecided	1	2	2	1	0	0	--	0	0	1	4	11	12.0

Table 8. Fisherman reaction to the alternative of increasing mesh size in nets and holes in back of baskets

	POOL												
	9	10	11	12	13	14	15	16	17	18	19	TOTAL	PERCENT
Approve	0	1	0	2	4	3	--	1	0	2	5	18	19.6
Disapprove	13	7	8	0	11	6	--	1	3	8	9	66	71.7
Undecided	1	1	1	0	0	0	--	1	0	1	3	8	8.7

Table 9. Fisherman reaction to the alternative of making no change from the present regulations

	POOL												
	9	10	11	12	13	14	15	16	17	18	19	TOTAL	PERCENT
Approve	9	4	5	0	4	4	--	2	2	5	8	43	51.2
Disapprove	0	3	0	0	4	4	--	1	0	6	3	21	25.0
Undecided	3	2	4	1	2	1	--	0	1	0	6	20	23.8

Appendix Table 1. Questionnaire sent to commercial fishermen along the Mississippi River

TO: Commercial Fishermen Reporting over 500 lb. of Catfish Annually:

Dear Sir:

During the past six months, there has been considerable reaction to the proposed increase in size limit on channel catfish from 13 to 15 inches. This proposal resulted from several years of studying Mississippi River catfish populations. Studies have consistently demonstrated over-harvest in many pools, particularly in the lower river.

Most objections have come from around those pools where over-exploitation has been slight or have had a good year in the immediate past. Ideally, regulations would be adjusted from year to year to fit the needs of each pool. However, this would be impractical to regulate and coordinate with adjoining states. As a result, we must aim for uniform regulations which are to the best interest of all.

The increase in size limit, as pointed out in a previous report, would protect the fish during the period of maximum weight gain. In other words, fish when growing from 13 to 15 inches in length will nearly double in weight. The net result would be a 30% increase by weight of the fishermen's catch. Further, since most catfish do not mature until they reach 15 inches, there would be more adult fish available to spawn and perhaps reduce the chance of spawning failure.

Granted, this would cut deeply into the catch of small "individual" fish. However, the greatest disadvantage here would come to the market end. Fishermen generally get the same price regardless of fish size, whereas, markets frequently get higher prices for smaller fish.

It must be pointed out that changing the size limit is not the only solution to over-harvest. Gear and season restrictions, for example, are alternatives. I would like to explore your feelings toward some of these and more or less take a census of opinion. Therefore, would you please complete the enclosed questionnaire and return it to me.

Thank you for your cooperation.

Sincerely,

Don R. Helms,
Fisheries Biologist

attachment

Please complete and return the following questionnaire to:

Don R. Helms,
Fisheries Biologist
Rural Route 3, Box 63
Bellevue, Iowa 52031

A summary will be compiled and returned to you.

Name: _____

Pool(s) you fish: _____

Amount of each type of gear you fish for catfish:

Nets _____ Baskets _____

Lines _____ Seine _____

Gill and Trammel Nets _____

How many years have you fished for catfish in the Mississippi River? _____

Average weight of catfish you catch each year _____ (dressed) or _____ (whole)

Do you dress your fish before selling:
(indicate percent if you dress a portion) _____ (yes) _____ (no)

Average price per pound received in 1969 _____ (dressed) _____ (whole)

What is your outlet for catfish? _____
(i.e. do you sell to restaurant, local fish markets, ship to Chicago, etc.)

Do you fish primarily for catfish (____) or depend largely on other species (____)

Check the following statements you agree with:

A. ( ) Fishing for catfish in this pool is improving.
B. ( ) Fishing for catfish in this pool is getting worse.
C. ( ) Catfishing in this pool has good years and bad years with no overall change.
D. ( ) I see no problem with catfish in this pool.

I approve | I disapprove | I am undecide

Please comment on the following restrictions and indicate which in your opinion would be the most desirable. Use back of sheet if you need more space.

( ) ( ) ( ) 1. Raise the size limit from 13 to 15 inches. This would increase the average size of fish in your catch and eliminate a large share of the "individual" size fish (16 inch fish dress to 1 lb.), but would increase the total weight of harvest by 30%.

Comment:

( ) ( ) ( ) 2. Close the season during the spawning run. This may permit more fish to spawn. The biological value of this is questionable. However, fish caught during this period are generally of poor market quality which combined with increased seasonal harvest causes a drop in price. These fish, if not caught during the spawning run, would be available for harvest the rest of the year.

Comment:

( ) ( ) ( ) 3. Close the season to basket fishing for both sport and commercial.

Comment:

( ) ( ) ( ) 4. Close season periodically (say every 3rd or 4th year) as necessary to permit the population to recover.

Comment:

( ) ( ) ( ) 5. Increase mesh size in nets and holes in back of baskets.

Comment:

( ) ( ) ( ) 6. Make no change from present regulations. Without additional restrictions, the problem of over-harvest will take care of itself. It would be impossible to catch every last pair of catfish and cause them to become extinct. The population will no doubt continue on a marginal basis whereas the fishing pressure will balance itself against the economics of harvesting a sparse population.

Comment:

( ) ( ) ( ) 7. Other suggestions (you name it).

AN ANNOTATED LIST OF FISHES OF THE SOLDIER RIVER DRAINAGE

Don Kline
Fisheries Biologist

The knowledge of present fish distribution in the Soldier River compared with previous studies is necessary for continued management of this fishery.

Meek (1892) sampled the East Fork of the Soldier River near Charter Oak, Iowa. Harrison (1950) sampled the main stream setting up four stations in Harrison and Monona Counties. This information was later incorporated by Cleary (1956) in his chapter on fish distribution in Iowa Fish and Fishing (Harlan and Speaker, 1956).

The purpose of this study is to continue this inventory and examine the previous results for comparison. This paper contains notes on six families and 13 species of fishes. The present study added six new species to the list of fishes found in the Soldier River but failed to account for five species found by previous workers. Meek collected three families including six species and one species not collected in the present study. Harrison collected four families including ten species and four species not collected in the present study.

I wish to thank Larry Gepner and James Barry for their help in the field and laboratory during this study.

Description of Study Area

The description of the study area given in this report is a summary from two reports (Harrison, 1950 and Iowa Natural Resources Council, 1959). Both reports stress the importance of previous glacial, alluvial and loessial action coupled with subsequent erosion and soil formation on the resources of this section of Iowa. Topography of the area has been influenced by two glacial periods and loess deposits from the Missouri River.

The first significant glacial period was the Kansan, which completely covered the Nebraskan drift in western Iowa. A mature topography was developed on the Kansan by erosion before the advance of the Wisconsin glaciers. The Kansan drift that was not covered by substages of the Wisconsin glaciation was covered by loess deposits from the Missouri River during Wisconsin time. This loess covered the landscape up to 50 ft thick near the bluffs in Harrison and Monona Counties, but thins to about 4 ft in western Ida County where it covers the Wisconsin drifts.

The loess near the bluffs greatly influences the topography and there is a lack of a well defined drainage system. The Soldier River cut through the loess bluffs and formed a topography with high reliefs and because of the steep side slopes tributary streams form deep gullies near the river.

To the East the Kansan was not covered as thickly with loess and the former erosion developed topography was only slightly modified by the loess and later glacial drifts in Ida and parts of Crawford Counties.

Northern Ida County was covered by the Iowan and Tazewell substages of the Wisconsin in Glacial period, respectively (Figure 1). Iowan covered the Kansan in northern Ida County but did not influence its drainage patterns. The topography of the Iowan area is gently rolling.

Tazewell drift covered only the Iowan on the eastern side of Ida County. The topography of the Tazewell is gently rolling to flat and only the larger streams have formed mature valleys. Iowan and Tazewell drifts were covered by a relatively thin layer of loess from the Missouri River (up to 50 inches).

The soils of the Soldier River Drainage were derived from loess material and formed under a grass cover. The soils are grouped into two soil associations, the Marshall and Bottomland. The Marshall association contains the Monona-Ida-Hamburg and Marshall soils in this drainage.

The MIH soils found in eastern Monona and Harrison, western Crawford and southwestern Ida Counties were formed from coarse-textured calcareous loess. These soils developed on the hilly and steep land along the Missouri River and are characterized by severe erosion and low productivity. The Hamburg soils are found on the steepest slopes and are non-tillable, while the Monona and Ida soils are found in areas of less slope and are tillable.

The Marshall soils found in eastern Crawford and southeastern Ida Counties were formed from medium to coarse textured loess. Marshall soils occupy rolling terrain and under proper management are some of the best in the state of Iowa.

Bottomland soils in western Monona and Harrison Counties formed from alluvium transported by the Missouri and Tributary Rivers from upstream sites. The soils generally grade from the more productive ones near the bluffs to almost sterile sand dunes near the Missouri River.

The Soldier River is a tributary stream of the Missouri River and has a drainage area of approximately 445 square miles (Larimer, 1957). It flows entirely in the state of Iowa and has the smallest drainage area of the 19 rivers in Iowa associated with the Missouri River.

The Soldier River starts in southeastern Ida County and flows southwesternly through Crawford, Monona and Harrison Counties. The course of the river has been altered south of Pisgah, Iowa and a straightened channel has been constructed to speed the flow of water into the Missouri River. The Soldier River enters the Missouri River approximately 11 miles north of its original mouth after cutting through the Missouri River bluffs between Pisgah and Mondamin, Iowa, and flows for approximately 6.6 miles across the Missouri River bottom.

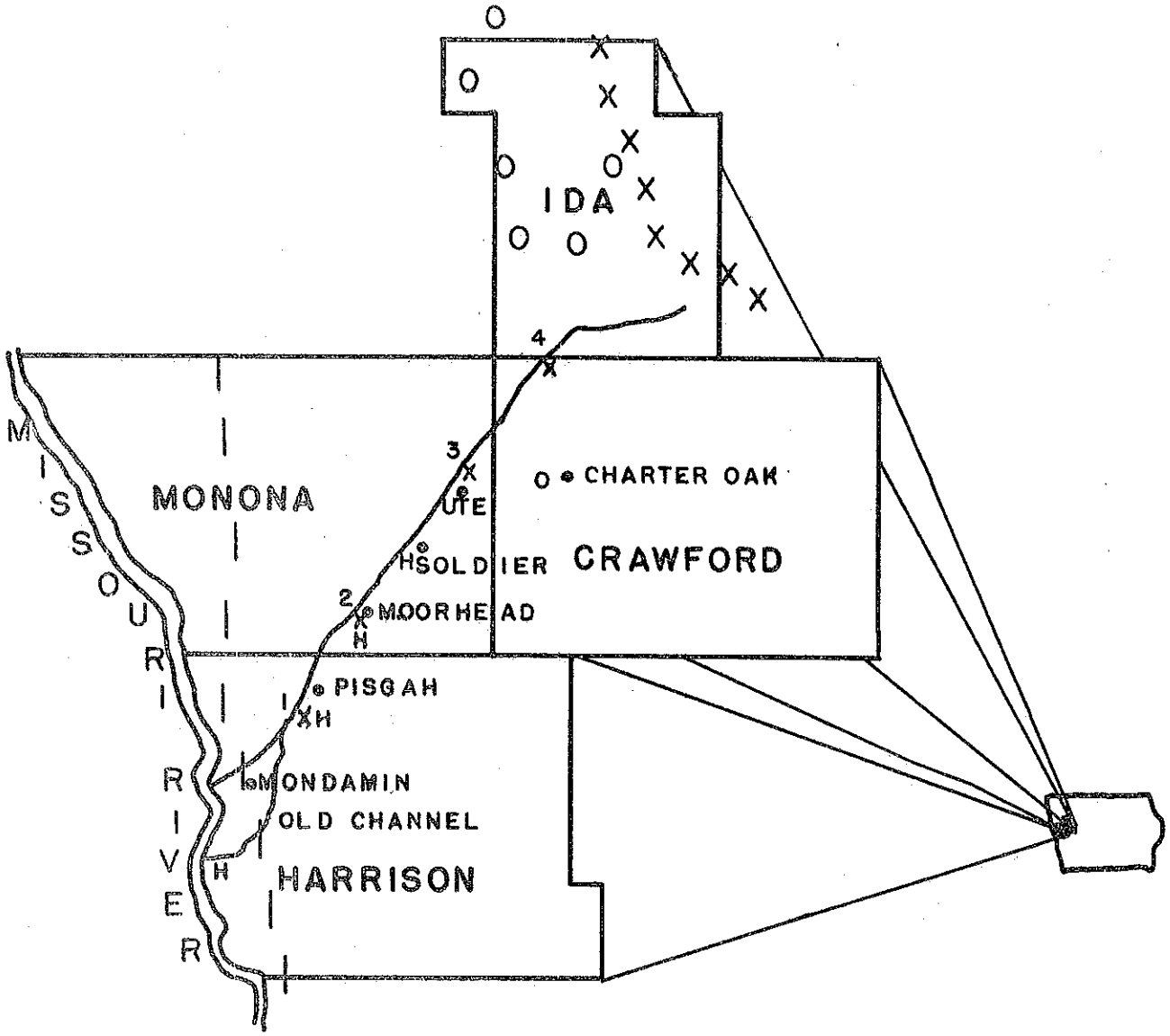

Figure 1. A sketch showing present sampling stations on the Soldier River in relation to two previous workers.

The towns of Schleswig, Charter Oak, Ute, Soldier, Moorhead, Pisgah and Mondamin are in the Soldier River drainage.

Water flow records taken near Pisgah, Iowa, show a maximum difference of 22,448 cfs and an average discharge of 126 cfs over the last 29 years. The 1969 record shows a maximum of 6,980 cfs in March and a minimum of 9.0 cfs in December with an average discharge of 162 cfs. The Soldier River does maintain a flow during normal water years although during dry years the stream may become intermittent for most of its length.

The Soldier River has been straightened and or dredged from its mouth to the Ida County line. Drifts, brush piles, pool areas and adjacent timber belts were removed at the time of "improvement". The banks naturally rise perpendicular to the stream bottom because of the erosion characteristics of the loess soil and have very little protective plant cover. Meandering of the stream has created a pattern of alternating sand bars that are colonized by forbs during summer months.

Procedures

Fish were captured using the seine and Pro-Nox Fish (rotenone) in the Soldier River. Seine hauls were made at three stations using a 35 X 6 foot, 1/4 inch mesh seine.

Pro-Nox Fish (rotenone) was used at two stations on the Soldier River. A 1/4 inch mesh block net was hung on reinforcing bars across the downstream end of the sample station. Pro-Nox fish was mixes in a bucket with water and poured across the upstream end of the sample station. Additional dosages of mixed Pro-Nox Fish were put along the edges in the upper quarter of the station and allowed to slowly disperse. Pools and backwaters were similarly treated and all rotenone was put into the water as quickly as possible.

A standard concentration in ppm was not an effective sampling technique because of the irregularity of the bottom and the presence of swift flowing water with backwater on one or both sides. Downstream surveillance and the presence of fish in the block net indicated each station was sampled with very little undesired kill. The block net was left across the stream for one-half hour.

All fish collected were preserved in 10% formalin and returned to the laboratory for positive species identification and enumeration. Subsamples of preserved fish were measured to the nearest millimeter and used to determine the average length and range.

The stations were inspected for physical and ecological characteristics after the fish collections were made. Measurement of the cfs was made using a 50 foot cord, stop watch and cork after the procedure described by Lagler, 1956. Field notes were taken on a standardized form with space available for additional notes on fish species or other fauna. Color slide pictures were taken on each station.

Fish species were classified as rare, common, or abundant using the following combination of criteria:

	Specimens		Stations
Rare	1 or 2	at	1 or 2
Common	several	at	2 or 3
Abundant	many	at	3 or more well separated

Stations

Fish samples were taken from four stations along the Soldier River. Stations were selected that would be evenly distributed along the river but still comparable with the previous study. The following is a list of stations discribing their physical and ecological characteristics. The stations are listed from 1 to 4 starting at the station nearest the mouth (Figure 1). The County, Township and Range numbers are given first, then the exact location by section. Seven additional characteristics are bottom type, flow in cfs, depth - deepest, gear, vegetation - presence and type, shore - bank type and principal cover and habitat.

Station 1. Harrison (43), T-81N, R-44W, Sec. 27 center.
Bottom - sand.
Flow - 49.7 cfs.
Depth - to 2 ft.
Gear - 3 seine hauls, 25 September, 1969.
Vegetation - none, willows overhanging high banks.
Shore - high banks.
Habitat - large sand bars and adjacent shallows, no pool areas.

Station 2. Monona (67), T-82N, R-43W, Sec. 10 south.
Bottom - sand.
Flow - 34.5 cfs.
Depth - to 1 ft.
Gear - 2 seine hauls, 25 September, 1969.
Vegetation - none, willows overhanging high banks.
Shore - high steep banks, cropped to edge of bank.
Habitat - large sand bars and adjacent shallows, pea-gravel at head of sand bars, no pools.

Station 3. Monona (67), T-84N, R-42W, Sec. 22 southeast corner.
Bottom - sand and pea-gravel.
Flow - 11.7 cfs.
Depth - to 7 inches.
Gear - 1 seine haul and rotenone, 21 July, 1970
Vegetation - sand bars covered with forbs.

Shore - high steep banks, cropped to near edge.
Habitat - alternating sand bars formed by meandering stream, sand island with accompanying side channel, silt on some bars.

Station 4. Crawford (24), T-85N, R-41W, Sec. 1 west.
Bottom - sand with coarse gravel, a few areas of muck knee deep.
Flow - 9.2 cfs.
Depth - to 6 inches.
Gear - rotenone, 21 July, 1970.
Vegetation - algae in still water and a few stalks of grasses.
Shore - high steep banks, some trees near bank.
Habitat - swift water in chute, beaver dam above 2.5 ft deep with silt bottom, creek enters above station but below dam.

Annotated List of Species

This list contains 13 species fishes from six families. Harrison reported ten species from four families and Meek reported six species from three families.

Notes contained in this list give the relative abundance, station (s), average length and range, records of previous work and a description of the habitat if the species is new to the list or more details are needed than given in the station description.

Clupeidae (herring family):

Dorosoma cepedianum (LeSueur). Gizzard shad. Common. Gizzard shad were taken with the seine at Stations 1 and 2. This species was the most numerous fish found at Station 1 where 63 were captured. The average length of gizzard shad at Station 1 was 113 mm (4.5 inches) with a range from 90 mm (3.5 inches) to 131 mm (5.2 inches). The collection made a Station 1 was a school of fish seen from the bridge. These fish had schooled below a shallow sand riffle area in about 6 inches of water. This species was not found by previous workers in the Soldier River.

Catostomidae (sucker family):

Carpiodes carpio (Rafinesque). River carpsucker. Rare. River carpsucker were collected at Stations 2, 3 and 4. Collections were made with the seine at Station 2 and rotenone at Stations 3 and 4. Those captured at Stations 3 and 4 measured 39 mm (1.5 inches) and 86 mm (3.4 inches), respectively. Their habitat preference seems to vary since they were not collected in any one habitat. This genus has not been taken by previous workers in the Soldier River.

Cyprinidae (minnow family):

Phenacobius mirabilis (Girard). Plains suckermouth minnow. Rare. One plains suckermouth minnow was captured at Station 4 using rotenone. The specimen measured 110 mm (4.3 inches). This station was the only one with coarse gravel and muck in the bottom type and a chute of swift water. This species has not been reported in the Soldier River by previous workers.

Semotilus atromaculatus (Mitchill). Creek chub. Common. Creek chubs were collected at Stations 3 and 4 using rotenone and seine. The rotenone sample at Station 4 produced 188 creek chubs with an average length of 88 mm (3.5 inches) and a range from 40 mm (1.6 inches) to 176 mm (6.9 inches). Meek found this species in the East Fork but Harrison did not find it in the main stream.

Hybopsis gracilis (Richardson). Flathead chub. Common. Flathead chubs were captured at Stations 3 and 4 using rotenone and seine. They were most numerous at Station 3 where 50 specimens were collected. The average length of 32 chubs was 85 mm (3.35 inches) with a range from 51 mm (2.0 inches) to 157 mm (6.2 inches). Harrison found these chubs near Stations 1 and 2 of the present study, but Meek did not find them.

Pimephales promelas (Rafinesque). Fathead minnow. Abundant. Fatheads were collected at Stations 2, 3 and 4 using rotenone and seine. Stations 3 and 4 were the most productive with 59 and 42 fish, respectively. The average length of 15 fatheads was 57 mm (2.3 inches) with a range from 41 mm (1.5 inches) to 70 mm (2.8 inches). Meek reported this species near Charter Oak, Iowa. Harrison reported fatheads abundant in Harrison County, but rare in Monona County.

Notropis atherinoides (Rafinesque). Emerald shiner. Common. Emerald shiners were captured at Stations 1 and 2 using the seine. The average length of 5 emerald shiners was 59 mm (2.3 inches) with a range from 56 mm (2.2 inches) to 63 mm (2.5 inches). The main characteristic of the river in the section covered by the first two stations was large sand bars with shallow water adjacent. Meek and Harrison did not find this species in the Soldier River.

Notropis lutrensis (Baird and Girard). Red shiner. Abundant, Red shiners were captured at Stations 1, 2 and 3 using seine and rotenone. Station 3 yielded 30 specimens while Stations 2 and 3 yielded 18 and 5, respectively. The average length of 10 red shiners was 60 mm (2.4 inches) with a range from 50 mm (2.0 inches) to 73 mm (2.9 inches). Meek did not take this species, and Harrison found them rare near Soldier, Iowa.

Notropis deliciosus ssp. (Cope). Sand shiner. Abundant. Sand shiners were the most widely distributed fish in the Soldier River being taken at all stations. The largest number (769) were collected at Station 3. The average length of 40 sand shiners was 63 mm (2.5 inches) with a range from 50 mm (2.0 inches) to 80 mm (3.2 inches). Surprisingly, previous workers had not reported this species.

Notropis dorsalis (Agassiz). Bigmouth shiner. Abundant. Bigmouth shiners were the second most widely distributed fish in the Soldier River being captured at all stations. The largest number (338) were captured at Station 3 using rotenone and seine. The average length of 41 bigmouth shiners was 55 mm (2.2 inches) with a range from 37 mm (1.5 inches) to 70 mm (2.8 inches). Meek reported this species in the East Fork but Harrison did not find them.

Ictaluridae (Catfish family):

Ictalurus melas (Rafinesque). Black bullhead. Common. Black bullheads were collected at Stations 3 and 4 using rotenone and seine. These fish were small with an average length of 36 mm (1.4 inches) range 29 mm (1.2 inches) to 51 mm (2.0 inches) and very little habitat was found that might substain a bullhead fishery. Meek reported this species and Harrison found it more common in the lower reaches of the river.

Serranidae (Bass family):

Roccus chrysops (Rafinesque). White bass. Rare. One white bass was captured at Station 2 using the seine. It was found in the swift channel area over a moving sand bottom. This species was not found by previous workers and is a new species to the list of western Iowa streams.

Centrarchidae (Sunfish family):

Lepomis cyanells (Rafinesque). Green sunfish. Common. Green sunfish were found at Stations 3 and 4 using rotenone and seine. The average length of 7 fish was 57 mm (2.3 inches) with a range from 32 mm (1.3 inches) to 102 mm (4.0 inches). Meek reported this species near Charter Oak, Iowa, and Harrison found it rare near Soldier, Iowa.

Discussion

The present study added gizzard shad, river carpsucker, sand shiner, emerald shiner, plains suckermouth minnow and white bass to the list of fishes of the Soldier River. Gizzard shad, emerald shiner and white bass were captured with the seine and the plains suckermouth minnow was captured with rotenone. River carpsucker and sand shiner were collected with seine and rotenone.

The plains suckermouth minnow was taken at Station 4 over a coarse gravel bottom. Gizzard shad and emerald shiners were captured at Stations 1 and 2 over large shallow water sand bottom areas. The white bass was collected at Station 2 from the swift current over sand bottom. Most of the river carpsucker and sand shiners were taken at Station 3 where the water was shallow (less than 7 inches) over most of the bottom and a narrow chute along the outside of the bend at a depth of 2.0 feet.

Stations 1 and 2 of the present study were near locations used by Harrison in 1950. Comparison of the notes taken at the two locations show marked differences in the ecology and fishes present. Harrison noted 50% of the bottom type was loblolly (fine sand and silt) and the other 50% as sand. The present stream bottom is almot 100% sand in those areas. Harrison found the flathead chub and fathead minnow common to abundant at both locations and the carp, black bullhead and longnose gar rare at the lower location. The present study found 5 species at the lower station and 8 at the upper one. This increase in the number of species may indicate a partial recovery of the stream since channelization.

The difference between the kind of fishes found is even more striking. The small number of fathead minnows found at Station 2 in the present study is the only similarity between the two studies. The large sand bars favoring such species as emerald shiner must be greatly different from the habitat available before channelization.

Minnows were found at all stations, but the lack of access to the water would discourage seining. No habitat exists that would support a channel catfish or bullhead fishery in all but the first few miles above the mouth.

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GIANT CANADA GOOSE RESTORATION PROJECT

Richard Bishop
Waterfowl Biologist
and
Ronald G. Howing
Unit Game Manager

The purpose of this project is to re-establish free-flying breeding Canada geese (Branta canadensis maxima) in northwest Iowa. Nesting Canada geese were common nesters in Iowa prior to about 1900. Due to over exploitation, most wild nesting populations of Canada geese were exterminated in Iowa by about 1900. Free-flying Canada geese have been successfully re-established in Missouri, Ohio, Wisconsin and other states. It is desirable to re-establish free-flying Canada geese in Iowa for the enjoyment of the public and to provide additional geese for hunters to harvest.

Procedures

Sixteen adult pairs of pinioned Canada geese (Branta canadensis maxima) were bought in 1964 from persons in Minnesota and South Dakota. These geese are probably progeny of Canada geese that originally nested in Iowa, Minnesota and South Dakota. They were kept captive in the Ingham Lake breeding pen (Figure 1) and the young raised during the years 1964-66 were pinioned to build up the captive breeding flock.

Elevated structures (platforms and barrels) and man-made dirt islands were constructed in the Ingham Lake breeding pen. Elevated structures (barrels and basket nets) were installed on marshes in the vicinity of Ingham Lake for use by free-flying geese. In many states with Canada goose projects, predation was a serious limiting factor. By providing safe man-made nesting sites in the breeding pen, it is believed that the young geese raised there will be imprinted and will select safe nexting sites in the wild.

In 1967 a Canada goose refuge 120 square miles in size was established around the Ingham Lake breeding pen by closing parts of Emmet and Palo Alto Counties to Canada goose hunting.

With adequate protection from hunting, all young Canada geese raised at Ingham Lake since 1967 were released as free-fliers.

Young clipped Canada geese bought from goose raisers in northwest Iowa during the period 1967-69 were used as a call flock at the Red Rock Refuge east of Des Moines, and then brought to Ingham Lake breeding pen by early December each year. Canada geese from Red Rock numbering 153 in 1968, 66 in 1969, and 128 in 1970 was allowed free-flight when they moulted as yearlings to supplement released geese raised at Ingham Lake.

Results

Breeding and production from the Ingham Lake captive flock:

The results of seven years of nesting activity from the captive flock at Ingham Lake are summarized in Table 1.

Most of the geese nested on the islands, platforms or in barrels. Most of the ground nests were destroyed by raccoon or skunk until 1970. During 1970 the area around the goose pen was intensively trapped to reduce predation of ground nests. No ground nests were destroyed by predators during 1970. However, abandonment of ground nests was high during 1970 due to overcrowding and territorial conflicts between geese. Nest abandonment was lower on the elevated nesting sites where it appeared that the geese were able to defend their territory better and possibly felt more secure.

Dogs got into the goose pen twice prior to nesting during 1969 and killed several of the captive geese. Nesting activity was curtailed in 1969 because of this unfortunate incident.

The geese usually start laying eggs the first week of March and complete hatching by the last week of May.

Mortality of young released as free-fliers:

Hunting does not appear to be limiting the re-establishment of nesting flocks in northwest Iowa. Only eight recoveries were reported from 183 Canada geese banded in the period 1967-69 at Ingham Lake (Table 5).

The percent of first year recoveries is lower than second and third year recoveries (Table 5). Most young apparently stay with the family groups within the Canada goose refuge in northwest Iowa until after hunting seasons are over. In past years they have left northwest Iowa in December after most goose seasons are over and therefore have experience very light mortality. A few birds taken as 2 year old birds (all males) have been scattered through neighboring states with no clear cut pattern. As more birds are produced an earlier migration and higher gunning mortality is expected.

Establishment of breeding free-flying geese in northwest Iowa:

A summary of observations of free-flying breeding Canada geese in northwest Iowa is presented in Tables 2, 3, and 4, and Figures 2 and 3. Occasional breeding Canada geese were observed in the wild prior to 1966. However, it is believed that most of these geese escapted from local goose raisers.

It appears that most geese are selecting relatively safe nesting sites (Table 2). Muskrat huts, when available, appear to be the best nesting sites. Barrels appear to be next best with islands, ditch banks, basket nests and other ranking respectively.

Approximately 75% of the nesting is occurring within five miles of the Ingham Lake breeding pen (Table 3 and 4, and Figures 2 and 3). It is possible that the geese nesting in the Spirit Lake area are from the 1965 Heron Lake, Minnesota release.

FUTURE DIRECTION AND RECOMMENDATIONS

The ever-increasing demand for Canada geese by both the hunter and the general public has generated a response in conservation agencies throughout the Mississippi Flyway. Many states have been working diligently to increase certain flocks of Canada geese that are providing shooting for their hunters. Also several states have embarked upon home grown flocks of the giant Canada goose with striking success. These home-grown flocks are providing additional birds for the hunter while fulfilling a demand by the general public to see these magnificent birds.

The Ingham Lake goose flock has only recently increased to the population level capable of providing some birds for shooting plus expanding their nesting activities over adjacent marshes and private sloughs. This project has met with much interest and public support which justifies the project on aesthetic values along.

From the hunting aspect and increased demand by the general public to see these birds re-established as common nesting birds over most of the prairie marsh country of north central and northwest Iowa, it is recommended that this project be expanded to established these birds as a prominent species for harvest and public enjoyment.

In order to expand the population, additional key refuges are needed to maintain a breeding nucleus. These birds are quite vulnerable to the gun on their natal areas and thus must be given some protection. It is believed that two additional refuge areas and breeding flocks (one in the Spirit Lake area at Kettleson Hogsback, and one near Ruthven on Dewey's Pasture) could provide for protection for enough of these birds to maintain a population level high enough to utilize the surrounding habitat. These three refuges would triangulate the biggest portion of the marsh country in northwest Iowa. An additional flock should be established at Rice Lake in the spring of 1972. It is recommended that the overall adult flock be built to about 5,000 birds of which about 2,000 would be adult breeders producing an annual crop of about 2,000 goslings.

We feel the cost of this program is far outweighed by the return of birds in the bag and public enjoyment of the nucleus flock. Other states have found that the public relations aspects from an interested public have promoted other fish and game programs and gained valuable department support.

Table 1. Captive Canada goose flock breeding and production data - 1964-70*

Years	Number Nests	Average Clutch	Percent Successful	Number Eggs	Percent Hatched	Average Brood Size	Goslings Raised	Number Goslings Banded
1964	**	**	**	**	**	3.4[1]	24[1]	***
1965	12	**	**	**	**	**	17[1]	***
1966	21	**	**	**	**	**	60[1]	***
1967	19	**	68	**	**	4.1[1]	54[1]	52[2]
1968	26	5.1[3]	69	96[3]	82[3]	4.2[4]	79[4]	83[2]
1969	22	**	**	**	**	**	52[1]	48[2]
1970	52	5.3	71	274	52	3.9[4]	144[4]	101[2]
TOTALS	152	5.2	70	**	60	4.0	430	284

* Data from flightless adults held in 24.3 acre pen.
** Breeding records not available.
*** All young were pinioned to build up captive breeding flock.

1 Based on brood counts.
2 Goslings were banded and released as free-fliers.
3 Eggs from 19 of the 26 nests - number of eggs from 7 nests unknown.
4 Based on eggs counted that hatched from successful nests.

Table 2. Free-flying breeding and production data - 1966-70**

Years	Number Nests	Site of Nests	Average Clutch	Percent Successful	Number Eggs	Percent Hatched	Average Brood Size	Estimated Number Goslings	Number Goslings Banded
1966	1	M. Hut	6.0	100	6	100	6.0[1]	6[1]	0
1967	2	M. Hut	**	100	**	**	5.0[1]	12[1]	0
1968	3	M. Hut	**	100	**	**	5.0[1]	15[1]	0
1968	4	Unknown	**	**	**	**	5.0[1]	20[1]	8
1969	2	Basket	5.5	100	11	100	5.5[2]	11[2]	0
1969	4	Barrel	5.7	100	23	73	4.2[2]	17[2]	0
1969	3	M. Hut	5.0	60	15	60	4.5[2]	9[2]	0
1969	1	Ground	5.0	100	5	100	5.0[2]	5[2]	0
1969	2	Unknown	**	**	**	**	5.0[1]	10[1]	0
1970	10	Basket	5.0	60	50	56	4.8[2]	28[2]	7
1970	7	Barrel	5.6	100	39	100	5.6[2]	39[2]	17
1970	11	M. Hut	5.4	91	59	90	5.3[2]	53[2]	0
1970	1	Ground	2.0	100	2	100	2.0[2]	2[2]	0
1970	3	Ditch Bank	3.7	66	11	82	4.5[2]	9[2]	0
1970	1	Duck Blind	6.0	100	6	100	6.0[2]	6[2]	0
1970	4	Island	3.2	75	13	70	3.0[2]	9[2]	3
1970	4	Unknown	**	**	**	**	4.0[1]	16[1]	0
TOTAL	63	--------	5.0	76[3]	240[3]	81[3]	4.7	267	35

* All young were left in the wild as free-fliers.
** Breeding records not available.

1 Based on brood counts
2 Based on eggs counted that hatched from successful nests.
3 Data from observed nests only.

Table 3. Distribution of free-flying nesting Canada geese, 1970

	Distance from Breeding Pen in Miles					
	0-5	5-10	10-15	15-20	20-25	25-30
Number Nests	31	2	5	2	1	1
Percent Nests	75	5	11	5	2	2

Table 4. Distribution of free-flying nesting Canada geese, 1969

	Distance from Breeding Pen in Miles					
	0-5	5-10	10-15	15-20	20-25	25-30
Number Nests	10	0	0	1	0	1
Percent Nests	80	0	0	8	0	8

Table 5. Band recoveries from Canada geese banded as goslings, 1967-69

Year	Number Banded	Year and Number Recovered			Total	
		1967	1968	1969	Number	Percent
1967	52	0	2	2	4	8
1968	83		0	3	3	4
1969	48			1	1	2
TOTALS	183	0	2	6	8	4

Figure 1. Schematic Diagram of Ingham Lake Goose Pen

24.3 Acres

Located in SW$\frac{1}{4}$, S1, T 98 N, R 33 W (Emmet County, Iowa)

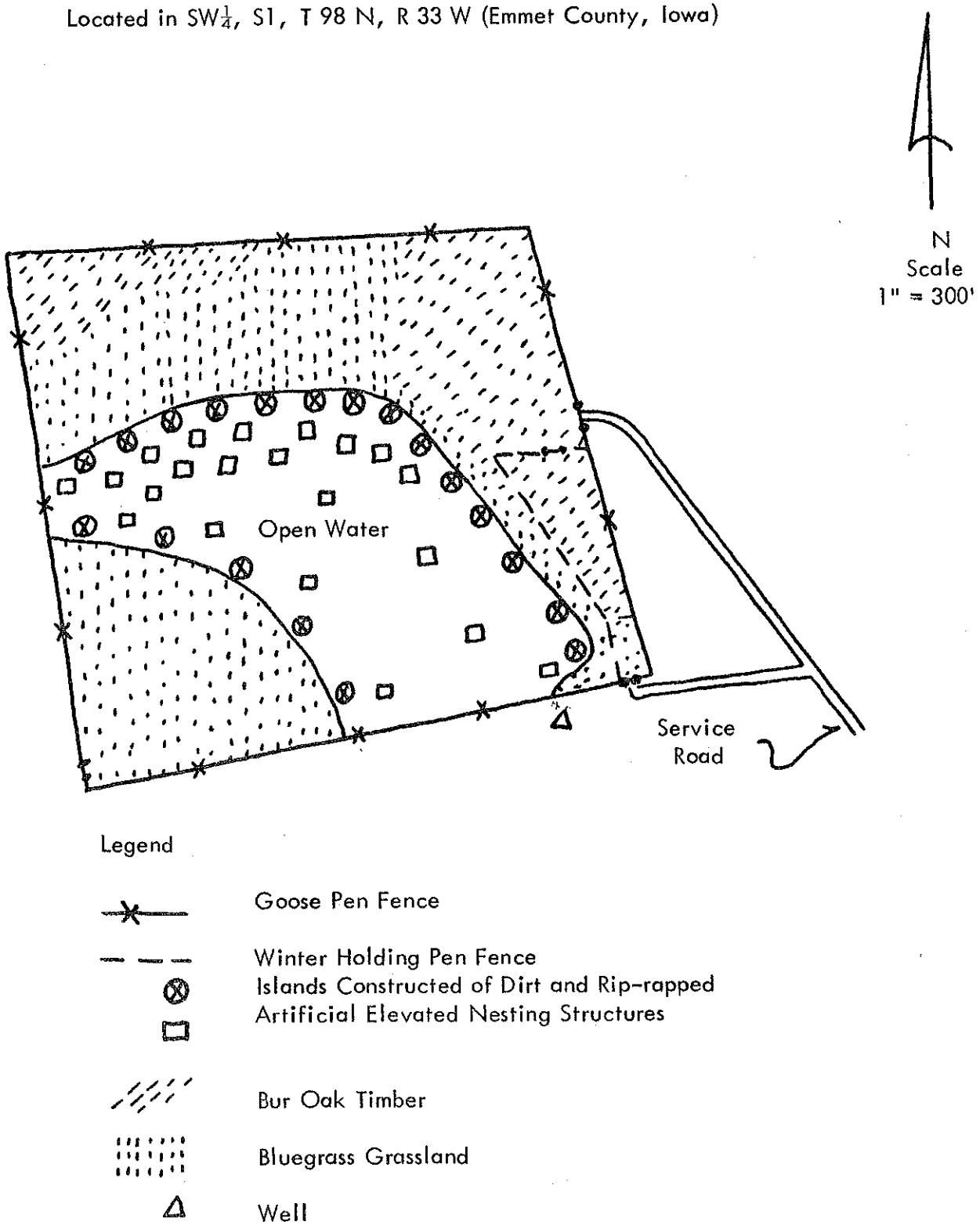


Figure 2. Map showing distributian of free-flying nesting Canada geese and Canada goose refuge boundary.

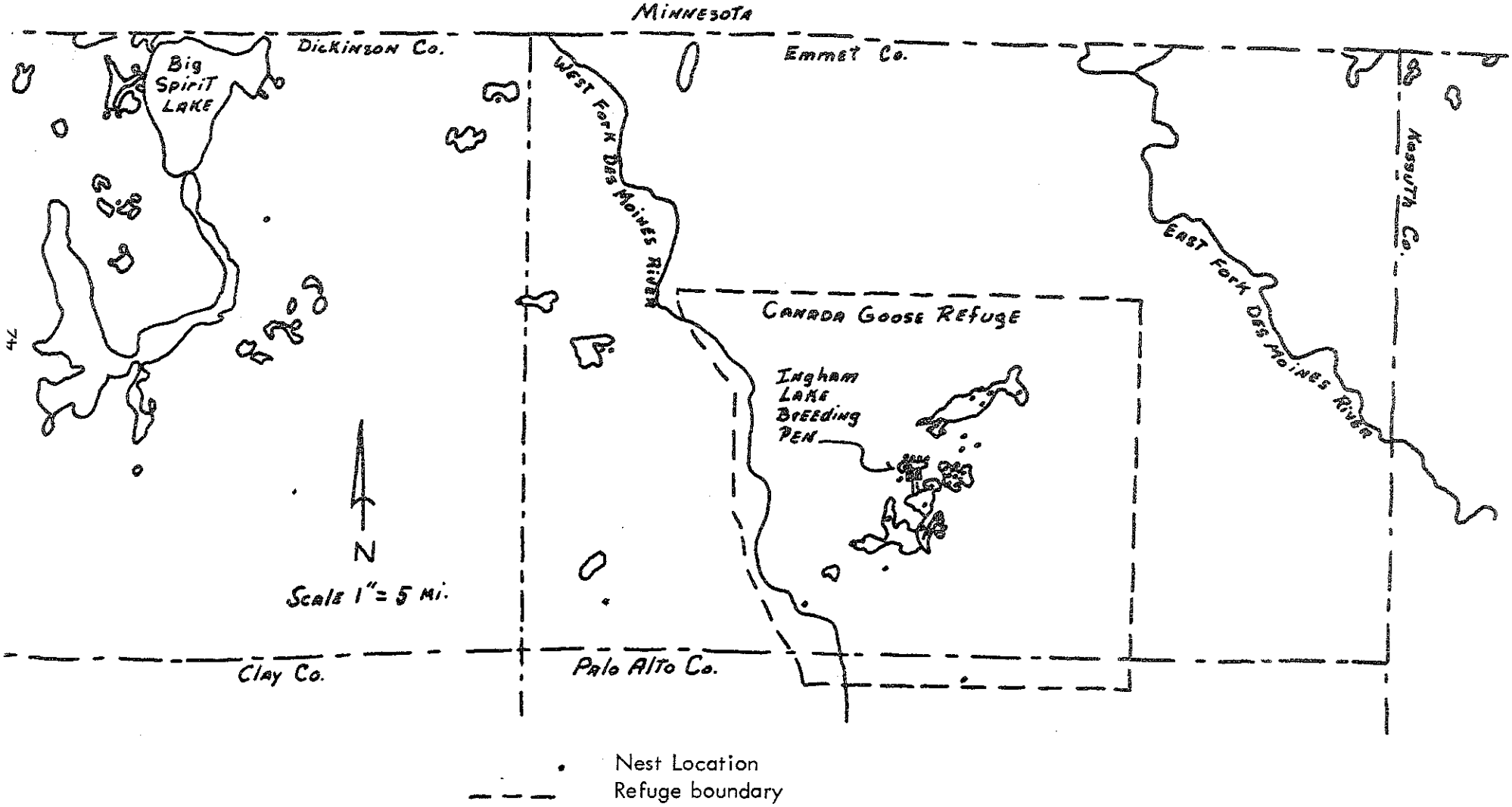
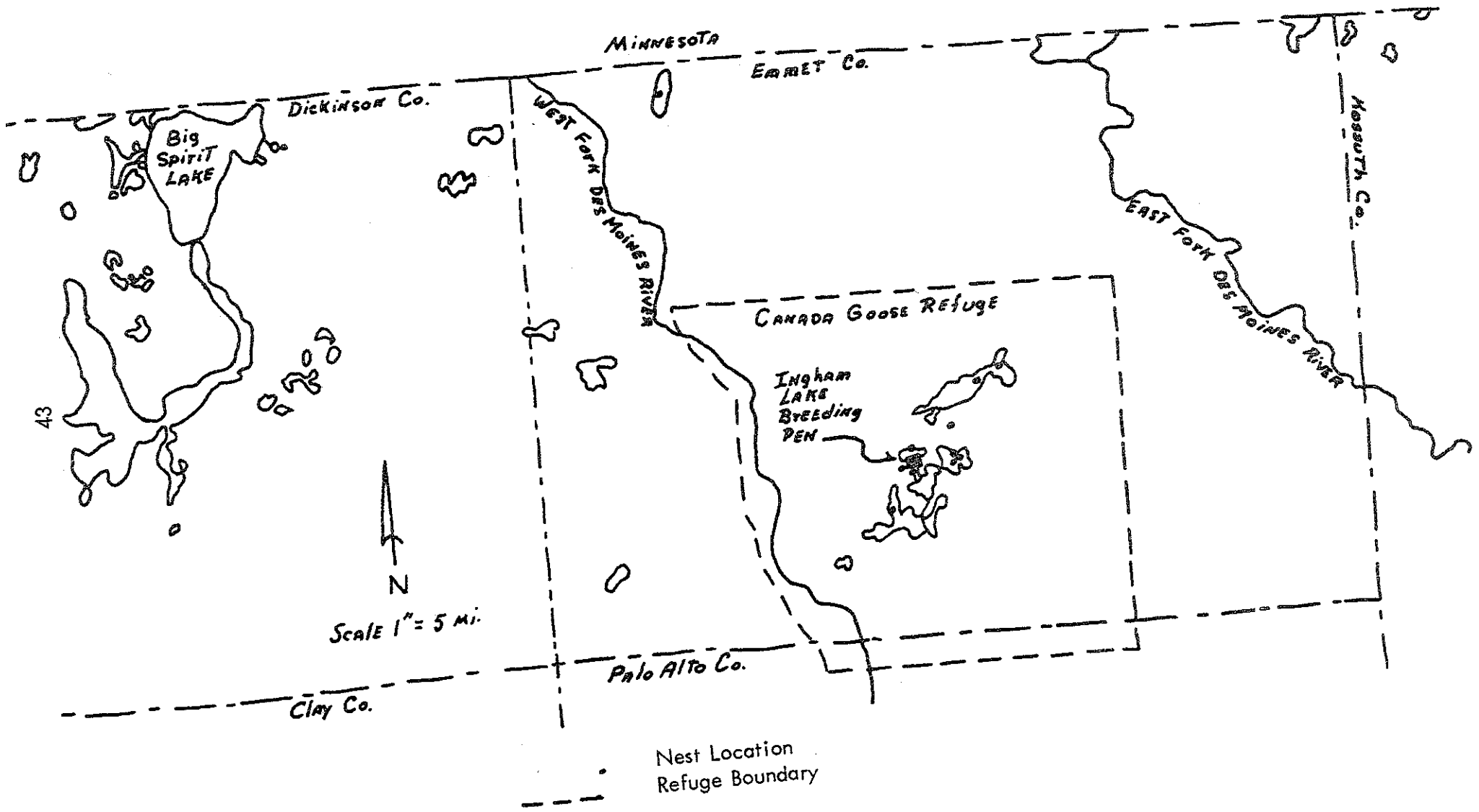


Figure 3. Map showing distribution of free-flying nesting Canada geese and Canada goose refuge boundary.



A NEW DEER CENSUS TECHNIQUE FOR IOWA

Lee Gladfelter
Game Biologist

Currently, Iowa determines the population trends of deer from winter officer estimates, harvest data, sex and age data, and miscellaneous mortality data. I would like to initiate the use of a new census technique for Iowa, which is to count deer tracks along prescribed census routes. Track counts will not be the complete answer to our census problems but hopefully it will add another trend indicator to lend validity to the present system. It should be emphasized that track counts will be used as a population trend indicator from year to year and should not be used in making a population estimate. In other words, track counts will be used to indicate whether the population is increasing, decreasing, or stable from year to year and not to indicate the exact number of deer in the population.

Discussion

Track counts have met with varying success in other states. Michigan could not come up with accurate results when compared to other population measurements. Wisconsin found that in the central portion of the state, track counts did indicate annual changes in the deer population. Minnesota considers track counts useful when used in combination with pellet group counts.

What are track counts? Routes of varying length will be set up along roads bordering good deer habitat. The route is driven and all deer tracks crossing the road are counted. In most states, a sand or dirt road is used and all previous tracks are eliminated by dragging the road the afternoon previous to the count. This is done by towing a drag made from a log or several old tires. The counts are usually conducted in the summer which may produce error because of the immobility of fawns during this time of year.

Since Iowa is not blessed with many sand or dirt roads, track counts will be conducted during the winter on mornings after a fresh snowfall. One advantage to this is that only the breeding population will be censused, with a relatively small amount of manpower expended. Some problems with this technique are also apparent. Censusing deer in southern Iowa will be difficult during winters of light snowfall. Another problem may be the herding of deer, which occurs during the winter, leading to difficulty in counting tracks where a large number of deer cross a road. There will undoubtedly be other unforeseen problems which will occur.

A great deal can be learned from track counts. Of primary importance is providing information on the trend of the deer population. Another important use of track counts will be to provide deer movement data in relationship to weather -- an essential fact in attempting to evaluate the effects of weather on deer harvest during Iowa's short

shotgun seasons. This movement data will be correlated with data from a deer telemetry study which will begin during the winter of 1970-71. Also, track counts will provide data on deer behavior, distribution, and abundance.

In analyzing track count data, it is necessary to be aware of two basic facts. First, how far does a deer travel during its nightly wandering, and does the deer begin and finish its nightly activity in the same area? Answers to these questions are difficult to obtain because of the many variables acting on the deer, such as: weather conditions, population density, availability of food and water, season of year, plus many others which cannot be measured. The only way that we can overcome some of these variables is to conduct the counts as many times as possible when favorable conditions occur. We can then obtain an average track count which considers counts made during many different weather conditions and at different times of the season.

Track counts will be conducted by unit game managers and biologists. During the winter of 1970-71, track counts will be conducted on an experimental basis with only about five routes in separate parts of the state. If the track counts prove feasible, then more routes will be added for the following winter.

Conducting Track Counts

1. A 5-10 mile continuous route through good deer country will be set up.

2. The route will be conducted as many times as possible following suitable weather conditions. Suitable weather conditions will be a snowfall the previous day which will be deep enough to allow identification of fresh tracks on the census day.

3. The goal is to run each route at least 3-5 times a month during the winter months. This frequency will provide a variation in weather conditions under which the routes are conducted (such as temperature, wind, humidity, etc.). An average will be computed for each route and then for the entire state, which will then be used for comparisons with following years.

4. The route will be driven at a speed of 3-5MPH and the number of deer tracks crossing the road in each one mile segment will be recorded. If necessary, the observer will at times have to stop the vehicle to determine exactly how many deer have crossed the road from either direction. It will take about three hours to complete each route with a starting time of 7-8 A.M.

5. Cover types along the road where tracks are counted will also be recorded.

6. An important part of the record will be weather data for the day of the count and for the previous night. This will be important in evaluating the movement of deer in response to weather conditions. A sample deer track count form is shown for reference.

Conclusion

An old technique for counting deer will be tested but at a different time of the year than in most states. There are advantages and disadvantages to this technique. With winter counts, time is not required for road preparation preceding the track count. However, without the cooperation of the weather, required frequency for counts may not be obtained. Because of a need for good population trend indicators the search for a good census technique must continue. If track counts do not prove feasible, then other census techniques such as aerial surveys or drive counts will be considered.

Deer Track Count Form

Name of Route: _____ Date: _____

County: _____ Observer: _____

Weather	(Day of Observation)	Previous Night
Temperature		
Humidity		
Wind Velocity		
Amount of Snowfall		
% Cloudiness		

Starting Time _____ Finishing Time _____

General Comments: _____

Mile	Sets of Tracks	Cover Type
1		
2		
3		
4		
5		
6		
7		
8		
9		
10		
Total		

IOWA'S LATE SUMMER PHEASANT POPULATION - 1970

Richard C. Nomsen,
Game Biologist

The August roadside pheasant count is the primary source of information on the status of the pre-hunting season pheasant population. There were 182 routes checked by conservation officers, Game Section personnel and biologists in 1970. A preliminary indication of reproductive success is also obtained from pheasant broods reported on July rabbit and quail routes.

The winter of 1969-1970 began early in December when a general snowfall covered the entire state. Although the winter was long and cold, it lacked the severe blizzards and drift storms that normally occur. Winter mortality was below normal to near normal in Iowa's pheasant range. A very mild April-May period seemed favorable for early nesting activity.

Results and Discussion

Birds per Mile:

There were 12,240 pheasants sighted on the 182 routes(5,460 miles) censused, for an average of 2.24 birds per mile (Table 1). This count showed a substantial increase of 47% over the 1.52 birds per mile reported in 1969.

Increases were reported in all regions of Iowa's pheasant range. The highest density was recorded in southwest Iowa followed by the central and east regions. Northwest Iowa experienced the greatest increase; however, the population there remains somewhat below the state average.

Broods per 30-Mile Count:

There were 1,546 broods sighted on the 182 rountes for an average of 8.5 broods per 30-mile count compared to 5.9 broods per count in 1969 (Table 2). More broods were reported in all regions of Iowa.

Percent of Hens with Broods:

There were 1,611 hens sighted and 1,208 (75.0%) were with broods (Table 3). The state-wide average was the highest in recent years and much above the previous 5-year average. All regional figures were above 71% with the central region reporting the highest at 80.1%.

Average Brood Size:

The state-wide average brood size was also higher this year - 6.3 chicks per brood

compared to 5.8 in 1969 (Table 3). Regional averages varied from 5.9 chicks in north central Iowa to 6.8 chicks in the south region.

Young per Hen:

Pheasant reproductive success continued to improve again this year. The young per hen index for 1970 was 6.0 which is the highest ever recorded. The state-wide average for 1969 was 5.0 young per hen. Regional figures ranged from 5.2-7.5 young per hen which indicates excellent reproduction for all areas of Iowa's pheasant range.

Hatching Date Distribution:

The hatching dates of 1,568 broods were determined from age information recorded on the survey forms. The peak hatching period occurred during June 1-10 which was earlier than 1969 (Table 4). Early spring weather conditions were very favorable for nesting activity and field work was completed on schedule. Mild weather continued through the month of May.

Pheasant Broods Sighted on Quail and Rabbit Counts:

Pheasant broods sighted along rabbit and quail survey routes were recorded and used as indicators of hatching success (Table 5). Statewide, there were 8.4 broods reported per 100 miles in 1970 compared to 5.4 broods per 100 miles in 1969.

Summary

1. The winter of 1969-1970 was long and cold, but it lacked the severe blizzards and drift storms that normally occur. Winter mortality was below normal to near normal in Iowa's pheasant range.

2. A very mild April-May period was favorable for early nesting activity. Field work was completed on schedule.

3. A total of 182 routes was check in 1970. Observers recorded an average of 2.24 birds per mile which was up 47% over the count taken in 1969.

4. Substantial increases were reported in all regions of Iowa's pheasant range. Highest counts were made in southwest, east and central regions.

5. Reproduction was excellent in all regions. The average of 6.0 young per hen was the highest ever recorded in this survey.

Table 1. Results of the 1970 August roadside pheasant counts, and comparison with 1969 results

Region of State	No. of Counts	No. miles Driven	Total No. Birds Sighted	Birds per Mile	1969 Birds per mile	% Change from 1969
Northwest	29	870	1,085	1.25	0.70	+ 78%
N. Central	27	810	1,802	2.22	1.84	+ 21%
Southwest	22	660	2,276	3.45	2.27	+ 52%
Central	30	900	2,539	2.82	1.83	+ 54%
East	36	1,080	2,481	2.29	1.61	+ 42%
South	38	1,140	2.057	1.80	1.16	+ 55%
STATEWIDE	182	5,460	12,240	2.24	1.52	+ 47%

Table 2. Comparison of number of broods sighted on August roadside pheasant counts in 1970 and 1969

Region of State	No. broods Sighted	Broods per 30 Mile Count	No. Broods Sighted 1969	1969 Broods per Count	% Change in Broods
Northwest	140	4.8	74	2.5	+ 92%
N. Central	230	8.5	171	6.3	+ 35%
Southwest	295	13.4	201	9.1	+ 47%
Central	338	11.3	208	7.4	+ 53%
East	294	8.2	211	6.8	+ 21%
South	249	6.6	169	4.7	+ 19%
STATEWIDE	1,546	8.5	1,034	5.9	+ 44%

Table 3. Data from 1970 August roadside pheasant count

Region of State	No. of Cocks	No. of Hens	Sex Ratio Index M : F	Hens Without Broods	Hens With Brood	% Hens With Brood	No. of Chicks	No. of Young Per Hen	No. of Young Per Brood
Northwest	100	150	1:1.5	42	108	72.0%	835	5.6	6.0
North Central	180	257	1:1.4	68	189	73.5%	1,365	5.3	5.9
Southwest	123	277	1:2.3	72	205	74.0%	1,876	6.8	6.4
Central	145	361	1:2.5	72	289	80.1%	2,033	5.6	6.0
East	191	369	1:1.9	105	264	71.5%	1,925	5.2	6.5
South	136	225	1:1.7	64	161	71.6%	1,696	7.5	6.8
STATEWIDE	875	1,611	1:1.8	403	1,208	75.0%	9,730	6.0	6.3

Table 4. Distribution of the 1970 Iowa pheasant hatch by regions and statewide for 1969-70 (Figures given are percentages by 10-day periods)

Date of Hatch		Northwest	North Central	Southwest	Central	East	South	1970 Statewide	1969 Statewide
May	1-10	---	---	---	---	---	---	---	---
	11-20	---	1.0	0.8	---	0.2	---	0.3	1.9
	21-31	2.8	6.3	6.7	12.2	13.1	11.9	9.8	8.2
June	1-10	27.8	15.0	38.5	19.2	34.4	37.9	28.6	29.6
	11-20	30.5	35.9	24.6	15.2	18.0	17.7	21.8	25.9
	21-30	26.4	29.6	15.5	25.2	24.9	21.1	23.6	18.8
July	1-10	9.0	6.3	10.7	13.7	2.0	9.2	8.8	10.4
	11-20	2.8	3.9	2.8	11.0	7.2	1.1	5.6	4.3
	21-31	0.7	2.0	0.4	3.5	0.2	1.1	1.5	0.9
August	1-10	---	---	---	---	---	---	---	---
	11-20	---	---	---	---	---	---	---	---
No. Broods In Sample		144	206	251	401	305	261	1,568	1,027

Table 5. Pheasant broods observed on 1970 mid-July rabbit roadside survey and quail whistling counts

Region of State	Rabbit Survey			Quail Survey			Combined 1970			1969
	No. Miles	No. Broods	Broods per 100 Miles	No. Miles	No. Broods	Broods per 100 Miles	No. Miles	No. Broods	Broods per 100 Miles	Broods per 100 Miles
Northwest	450	30	6.7	140	7	5.0	590	37	6.3	4.7
N. Central	420	52	12.4	130	6	4.6	550	58	10.5	6.5
Southwest	360	44	12.2	110	6	5.5	470	50	10.6	6.0
Central	450	45	10.0	140	5	3.6	590	50	8.5	5.2
East	600	66	11.0	190	16	8.4	790	82	10.4	5.2
South	510	26	5.1	200	7	3.5	710	33	4.7	5.2
STATEWIDE	2,790	263	9.4	810	47	5.2	3,700	310	8.4	5.4

RESULTS OF 1970 RABBIT SURVEYS IN IOWA

Gene Hlavka
Game Biologist

The July rabbit roadside counts were conducted in 1970 for the 21st consecutive year. Since 1950, this survey has been conducted with only slight modifcations. Conservation officer, biology and game personnel conducted the rabbit counts from July 10 to 20. In 1968, all routes were standardized as 30-mile routes. Starting at sunrise, observers drive 20-25 mph and record the number of rabbits sighted and, in addition, the number of quail, Hungarian partridge and pheasant broods sighted along the routes. Although this July rabbit survey was developed to obtain an index of abundance to the cottontail population, jack rabbits were also surveyed starting in 1958.

Rabbit age was recorded as adult or juvenile on the basis of size alone. Age ratios and the fall population index were computed from this data. Data obtained for other game sighted on the rabbit surveys was submitted to biologists assigned to the various species. Similar data on rabbits obtained from quail and pheasant surveys are documented in this paper.

Results

Ninety-four routes were surveyed this summer. The state-wide index of abundance to the cottontail population for 1970 was 4.70 cottontails sighted per 10 miles, which was up 11% from the 4.24 index of 1969 (Table 1). The 1970 state-wide index, however, is 7% below the 20-year average, 4.70 vs 5.03 (Table 2). Remember, in 1969, the state-wide cottontail population index dropped one-third from that of 1968.

Cottontails again are most abundant in the Southern Loess area (figure 1) which has a 1970 index of 9.03 (Table 2). This index is up 21% from the 1969 index of 7.48 and up 13% from the 20-year average. The Western Loess area is second in importance as far as cottontails are concerned. The 1970 index of 4.49 is 12% below the 1969 index of 5.08 and 22% below the 20-year average of 5.79.

The Northern Glaciated area showed a 32% increase - 2.86 in 1970 vs 2.16 in 1969. The 1970 index is 24% below the 20-year average. In the Eastern area, the 1970 index of 3.53 is 22% below the 1969 index of 4.50. Practically no change occurred from the 20-year average.

The state-wide juveniles-per-adult cottontail ratio for 1970 was 2.12 (Table 3). This compares with 1.93 in 1969. Best reproduction this year seemed to be in the Southern Loess and Eastern areas where the ratios were 2.66 and 2.24, respectively.

The state-wide fall population index for 1970 was 3.19 juvenile cottontails sighted per 10 miles. The fall population index is obtained by dividing the number of juvenile cottontails sighted by the number of survey miles and then multiplying by ten. The gain

in the rate of reproduction was 14% -- 3.19 in 1970 vs 2.79 in 1969. From 1966-68, this index was 4.00 or above.

Rabbits are also counted on the July quail whistling survey and the August roadside pheasant survey. On the July quail whistling survey the state-wide index increased 39% -- 6.30 in 1970 vs 4.53 in 1969 (Table 4). On the August roadside pheasant survey, the state-wide index declined 30% -- 1.54 in 1970 vs 2.20 in 1969 (Table 5). However, the August roadside pheasant survey is taken after the best time to count rabbits along the roadsides, so is not as reliable as the other surveys. The quail and pheasant surveys substantiated the previous indication that the best cottontail populations are in the Southern Loess area.

The spring pheasant surveys indicated that state-wide, our rabbit brood stock was up 6% -- 1.82 in 1970 vs 1.72 in 1969 (Table 6). The broad stock in the Western Loess area gained 37% from that of 1969. The Northern Glaciated brood stock gained 23%. The brood stock in the Southern Loess and Eastern areas remained about the same.

Jackrabbits are also counted on the preceding four surveys. The state-wide jackrabbit index obtained from the July rabbit survey increased 60% -- 0.08 jackrabbits sighted per 10 miles in 1970 vs 0.05 in 1969 (Table 1). In the primary jackrabbit range, this increase was 100% -- 0.12 in 1970 vs 0.06 in 1969. The 1970 jackrabbit brood stock, as indicated by the spring pheasant surveys, increased 100% from that of last year. The jackrabbit figures may not be very accurate because none of the surveys is designed especially for jackrabbits, and numbers sighted are small.

Discussion

Weather is the chief factor that affects short-term trends in population levels of small game animals. Winter and spring weather in 1970 was unusually favorable for Iowa game. January was cold, but dry. Precipitation was among the least of January record. February was sunny and also dry. March was cold with some minor flooding. April was notable for rapid transition from winter to advanced spring. April had above normal sunshine, wind movement and temperatures, coupled with subnormal rain falls. The April-May period was the mildest since 1945. Only thrice in the 20th century had April-May periods been significantly warmer than 1970; namely, those occurring in 1955, 1941 and 1934. A large portion of Iowa measure the last freeze on May 2 (Climatological Data - Iowa, for months concerned).

Statewide, a slightly improved supply of rabbits was on hand to greet this spring. With the favorable winter and spring weather of 1970, expectations for an increase in the rabbit population levels were substantiated by the July quail and rabbit surveys.

Summary

1. The July rabbit survey was conducted for the 21st consecutive year.

2. Ninety-four routes were surveyed in 1970.

3. Statewide indexes of abundance obtained from four surveys indicated three gains and one decline in cottontail populations as follows:

   Spring pheasant survey - cottontails up 6%
   Quail whistling survey - cottontails up 39%
   July rabbit survey - cottontails up 11%
   August pheasant survey - cottontails down 30%

4. The fall population index indicated a 14% gain in the cottontail rate of reproduction.

5. Winter and spring weather of 1970 was unusually favorable for rabbits.

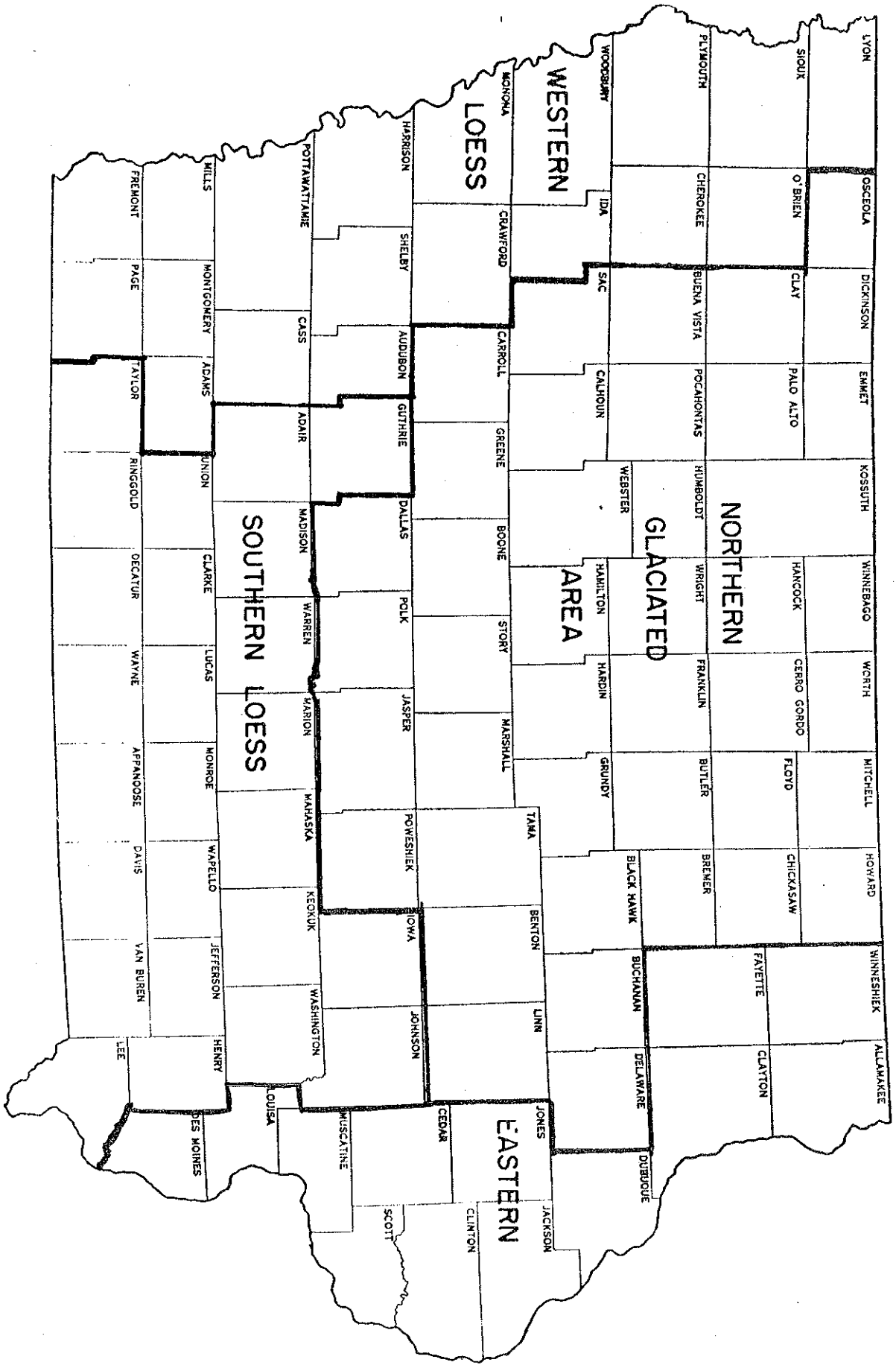


Figure 1. Regions of state used for analysis of rabbit survey data

Table 1. Rabbit indexes of abundance obtained from the July rabbit survey, 1970

Area	No. of Routes	Total Miles	Cottontail Sighted	Cottontails per 10 Miles 1970	Cottontails per 10 Miles 1969	Jackrabbits Sighted	Jackrabbits per 10 Miles 1970	Jackrabbits per 10 Miles 1969
Northern Glaciated	43	1,290	369	2.86	2.16	16	0.12	0.06
Western Loess	13	390	175	4.49	5.08	7	0.18	0.15
Southern Loess	23	690	623	9.03	7.48	0	0.00	0.01
Eastern	15	450	159	3.53	4.50	0	0.00	0.00
STATEWIDE	94	2,820	1,326	4.70	4.24	23	0.08	0.05

Table 2. Comparison of rabbit indexes of abundance for 21 years, 1950-70, expressed as cottontails sighted per 10 miles

Year	Northern Glaciated	Western Loess	Southern Loess	Eastern	STATEWIDE
1950	3.87	4.75	6.83	2.22	4.29
1951	3.37	6.69	5.68	2.13	3.92
1952	3.70	6.74	6.14	1.78	4.18
1953	2.70	4.26	4.23	3.33	3.31
1954	2.97	3.90	4.55	2.36	3.35
1955	4.60	3.55	6.03	5.31	4.96
1956	3.06	3.51	5.99	4.44	4.07
1957	3.32	4.72	7.59	4.79	4.87
1958	4.68	8.76	12.95	4.65	6.86
1959	4.36	7.92	10.46	4.66	6.33
1960	4.62	5.07	5.41	1.80	4.56
1961	4.25	6.12	6.58	2.19	4.79
1962	2.94	3.53	6.67	1.80	3.88
1963	4.19	5.27	10.17	3.87	5.61
1964	4.79	6.95	11.27	4.18	6.69
1965	3.95	5.11	11.59	4.31	6.05
1966	4.09	6.92	10.12	3.94	6.07
1967	3.96	8.67	9.86	3.87	6.11
1968	4.31	8.31	9.62	4.84	6.36
1969	2.16	5.08	7.48	4.50	4.24
20-yr avg.	3.75	5.79	7.96	3.55	5.03
1970	2.86	4.49	9.03	3.53	4.70

Table 3. Age ratios of cottontails sighted during July survey, 1970

Area	No. of Adults	No. of juveniles	Juveniles per Adult 1970	1969
Northern Glaciated	135	234	1.73	1.47
Western Loess	71	104	1.46	1.87
Southern Loess	170	453	2.66	2.15
Eastern	49	110	2.24	2.32
STATEWIDE	425	901	2.12	1.93

Table 4. Rabbit indexes of abundance obtained from July quail whistling survey, 1970

Area	No. of Miles	Cottontails Sighted	Cottontails per 10 miles 1970	1969	Jackrabbits Sighted	Jackrabbits per 10 miles 1970	1969
Northern Glaciated	400	149	3.73	2.79	4	0.10	0.13
Western Loess	120	75	6.25	4.92	2	0.16	0.08
Southern Loess	240	267	11.13	6.78	0	0.00	0.00
Eastern	150	82	5.47	5.36	0	0.00	0.00
STATEWIDE	910	573	6.30	4.53	6	0.06	0.07

Table 5. Rabbit indexes of abundance obtained from August roadside pheasant survey, 1970

Area	No. of Miles	Cottontails Sighted	Cottontails per 10 miles 1970	Cottontails per 10 miles 1969	Jackrabbits Sighted	Jackrabbits per 10 Miles 1970	Jackrabbits per 10 Miles 1969
Northern Glaciated	2,430	164	0.67	0.83	18	0.07	0.19
Western Loess	780	153	1.96	1.96	9	0.12	0.10
Southern Loess	1,170	377	3.22	4.83	1	0.01	0.00
Eastern	810	107	1.32	2.06	2	0.02	0.01
STATEWIDE	5,190	801	1.54	2.20	30	0.05	0.10

Table 6. Rabbit indexes of abundance obtained from spring pheasant survey, 1970

Area	No. of Miles	Cottontails Sighted	Cottontails per 10 miles 1970	Cottontails per 10 miles 1969	Jackrabbits Sighted	Jackrabbits per 10 miles 1970	Jackrabbits per 10 miles 1969
Northern Glaciated	1,804	172	0.95	0.77	48	0.26	0.13
Western Loess	606	154	2.54	1.85	18	0.29	0.16
Southern Loess	1,025	336	3.28	3.27	1	0.00	0.00
Eastern	606	75	1.24	1.26	0	0.00	0.00
STATEWIDE	4,041	737	1.82	1.72	67	0.16	0.08

IOWA QUAIL POPULATION, 1970

M. E. Stempel
Game Biologist

The July count of whistling cock quail is the primary means of determining breeding quail populations. A resume of this procedure is given in the 1963 July-September Quarterly Biology Reports. The method as initiated in Iowa is based on 97 10-stop routes distributed throughout the state.

Additional information used in calculating the prospective fall population is obtained each year from other game surveys on which quail are recorded. These censuses are taken from April through August. Information from all these counts gives a fairly complete picture of post-winter survival, summer adult populations, and of the production up to late summer.

Favorable weather preceeding pairing and nesting is necessary so that breeding quail will be in prime condition. In this respect, in the primary quail territory the 1969-70 winter had no excessive snowfall, and weather was mostly favorable to quail survival. Even the long period of cold did not appear to affect quail numbers. Spring populations were high. March weather was cold with some snow; April and May were mild and the balance of summer was favorable to quail. Quail populations and production were high as a result.

The censusing system and changes in the system are described in the Quarterly Biology Reports for July-September 1964 and for July-September 1967.

Results

Whistling Quail Census - statewide:

This July count measures annual variations in the number of Iowa breeding quail (Table 1). The 1970 count was made on 95 routes. On the total of 950 stops, 1,433 cocks were heard calling. This amounted to a mean of 1.51 per stop compared to the 1.62 for 1969.

In prime quail range (south-central and southeast) there was a 2% increase. In the areas which border the prime quail range (central and east) there was decrease while in the southwest there was increase. However, these areas have relatively few quail. In northern Iowa the number of quail is small and a precise measure of the population change is difficult to obtain.

Wapello and Decatur-Wayne County Research Area:

Sunrise whistling activity in quail begins in late March or in April. It ends by September. This activity is checked about once each two weeks. The number of call-

ing males is recorded along a 10-stop route at sunrise when the sky is clear and wind is moderate. This is the same procedure used on the statewide routes.

In 1970 as heard on routes, sunup calling began in April, peaked in June, with calling high into August. It continued fairly high to mid-August then slowed.

Sight Records in Conjunction with other counts:

On Spring Pheasant Counts: A measure of quail survival over the winter is obtained from the numbers of quail sighted on the April-May spring roadside pheasant surveys. In 1970 this covered 1,730 miles of 10-mile routes with 129 quail being seen which was an average of 7.46 per 100 miles. In 1969 along 1,560 miles 80 quail were seen which was an average of 5.13 per 100 miles. For the years 1968 back to 1962, the figures were 5.76, 4.31, 2.89, 2.15, 3.01, 2.83 and 1.20.

On Rabbit Counts: Quail are also counted on the regular July rabbit counts. These are made along roads that were selected because they are in rabbit territory, which in southern Iowa is also quail range. The procedure is described in the 1963 July-September Biology Report in the rabbit report. In 1970, this count was made on 2,820 miles of routes throughout the state. Altogether, 195 quail were reported seen for an average of 6.91 per 100 miles (Table 2). In 1969, the figure was 7.25; in 1968 it was 7.37; in 1967 5.77; while in 1966 it was 6.88 and in 1965 and 1964, results were similar to each other at 3.85. The number of coveys seen should be an indicator of the state of production. In this respect, young quail were seen on 5 routes in 1970; 9 in 1969, in 1968 11, in 1967 none were seen, in 1966 3, 2 for 1965 and 3 in 1964. Until this year if coveys were not recorded as such, any report of 9 or more quail having been at one place was considered as a covey. In 1968 for the first time young quail were counted and recorded separately from adults.

On August Roadside Pheasant Count: A late summer roadside pheasant count is made in August, with quail sighted also being counted. Along 5,160 miles of route, 461 quail were seen. This was an average of 8.94 per 100 miles, which is more than the 8.90 for 1969 (Table 3) and this figure can be compared to 6.54 for 1968 and it is above the 7.03 for 1967. Of the six districts, there was increase throughout the south and southwest. This territory alone has significant numbers of quail during any recent year.

On Calling Quail Surveys: Records are also kept of quail seen on whistling quail routes. In 1970, 121 were seen along routes comprising 950 miles which was 12.74 per 100 miles (or more correctly per 100 listening stops) since some stops are more than one mile apart, (Table 4). In 1969, the figure was 13.75 and in 1968 12.78. In 1967 the figure was 7.37, 9.79 in 1966 and 4.01 in 1965.

Discussion

In April and May, the first count is made of the adult quail which eventually produce the new coveys. This is done in conjunction with the spring pheasant survey.

This year it indicated that more quail survived the 1969-70 winter than in 1968-69. next to be taken is the whistling cock quail count in early July and this count showed a population similar to that of 1969. On this same census, 53 cooperators said they thought there were as many quail as in 1969. Twelve thought the population was higher. Others thought there were less. Only one cooperator in southern Iowa thought that the population was down. The June, July and August calling quail counts were made this year on the Wapello and Decatur-Wayne Research sites. On these sites we now have five years data and the 1970 data shows the May through August calling was nearly the same as in 1969. Overall, this indicates production at least as good as in 1969. Early July quail counts along rabbit survey routes indicated good numbers. This year, young were seen on five routes, the number was 9 in 1969.

Because of the relatively small number of quail sighted, rabbit and pheasant surveys made during the summer by Commission personnel, it is likely a better idea of the overall quail picture can be obtained by combining data from these three counts. When this was done, it was found that 8.70 quail were seen per 100 miles in 1970, compared to 8.87 in 1969, 7.17 in 1968, 6.67 in 1967, 8.38 in 1966, 5.68 in 1965, and 7.84 in 1964 (Table 5). It may be that in unusually dry years, quail are seldom seen as they do not then need to come onto the roads to seek dry places. It may also be true that wet seasons have yet a different effect. Many of the birds counted are adults, and thus, still must be classed as brood stock.

The August pheasant surveys show a higher proportion of young, and it is possible the change in numbers does to an extent reflect changes in production periods as well as annual fluctuations in production. Since 1960, there has been a succession of similar production periods, and quail numbers have increased slightly, or at least remained at similar levels. Changes of 20% or less are usually not noticed by the average shooter. However, a few more year's data on these recently revised quail counts will be necessary before their relative worth can be fully evaluated.

An always present difficulty in setting up censuses and changes in censuses, is illustrated in an experience of the 1969 summer. To better sample the late June calling cock quail peak, instructions and forms for the count were mailed earlier. This was done in late June. Usually the count was made in July. However, the 1969 season was very wet and the count was again made in July. Had it been taken in late June, the count of calling males would have been much higher; this was so on our research routes. In 1970 the counts were completed at an earlier date. This was due to more favorable weather. In 1970, the calling was at about the same level from mid-June to mid-July. This will be further discussed in a later report.

Table 1. July whistling quail counts - Iowa, 1970

Region of State	No. of Routes	No. of Stops	No. of Whistling Cocks	No. of Whistling Cocks per Stop	1969 Mean per Stop	Percent Change from 1969
Northwest	14	140	14	0.10	0.09	0
North Central	13	130	0	0.00	0.01	0
Central	17	170	212	1.25	1.71	-27
East	19	190	296	1.42	1.92	-26
Southwest	11	110	184	1.67	1.35	+50
South Central and South East	21	210	727	3.46	3.39	+ 2
STATEWIDE	95	950	1,433	1.51	1.62	- 7

Table 2. Quail observed on the July rabbit count, - Iowa, 1970

Region of State	No. of Routes	No. of Miles	No. Quail Seen	No. Quail Seen per 100 Miles	1969 - No. per 100 Miles	Percent Change from 1969
Northwest	15	450	0	0.00	0.00	0
North Central	14	420	0	0.00	0.00	0
Central	15	450	3	0.67	0.67	0
East	20	600	62	10.33	7.08	+46
Southwest	12	360	37	10.28	11.11	- 7
South Central and South East	18	540	93	17.22	21.33	-19
STATEWIDE	94	2,820	195	6.91	7.25	- 5

Table 3. Quail sighted on the August pheasant count - Iowa, 1970

Region of State	No. of Routes	No. of Miles	No. Quail Seen	No. Quail Seen Per 100 Miles	1969 - No. per 100 Miles	Percent Change from 1969
Northwest	30	900	0	0.00	0.00	0
North Central	24	720	0	0.00	0.00	0
Central	29	870	4	0.46	4.40	-90
East	36	1,080	77	7.13	9.00	-21
Southwest	21	630	129	20.48	12.58	+63
South Central and South East	32	960	251	26.15	23.24	+13
STATEWIDE	172	5,160	461	8.94	8.90	up

Table 4. Quail sighted on whistling quail counts - Iowa, 1970

Region of State	No. of Routes	No. Miles Driven	No. Quail Seen	No. of Quail Seen per 100 Miles	1969 No. Quail Seen per 100 Miles	Percent Change from 1969
Northwest	14	140	0	0.00	0.00	0
North Central	13	130	0	0.00	0.00	0
Central	17	170	10	5.88	7.50	-22
East	19	190	21	11.05	20.63	-46
Southwest	11	110	40	36.36	11.82	+208
South Central and South East	21	210	50	23.81	31.50	-24
STATEWIDE	95	950	121	12.74	13.75	-8

Table 5. A summary of combined results of quail sighted on calling quail census, rabbit count and pheasant survey, July and August - Iowa, 1970 and 1969

Region	1969 No. Routes	1969 No. Miles	1969 No. Quail Seen	1969 Quail Seen 100/Miles	1970 No. Routes	1970 No. Miles	1970 No. Quail Seen	1970 Quail Seen 100/Miles	Percent Change 1969-1970
Northwest	58	1,480	0	0	59	1,490	0	0.00	0
North Central	51	1,290	0	0	51	1,270	0	0.00	0
Central	59	1,250	52	3.59	61	1,490	17	1.14	-68
East	62	1,540	148	9.61	75	1,870	160	8.56	-11
Southwest	45	1,130	136	12.04	44	1,100	206	18.73	+56
South Central and South East	76	1,180	442	23.51	71	1,710	394	23.04	-2
STATEWIDE	351	8,770	778	8.87	361	8,930	777	8.70	-2

FOX MOVEMENT STUDIES

Ron Andrews
Game Biologist

In order to properly manage and assess the red fox (Vulpes fulva) as a game animal and predator in Iowa, it is necessary that we have a current knowledge of its population status, productivity, movements, mortality, and food habits. In 1966, a movement and mortality project was initiated. The objectives of the study were to capture, ear tag and release fox pups at their natal dens to determine the extend of movement of fox pups from the denning area, and to determine the effects of hunting, trapping and other causes of mortality on Iowa fox populations. This year, 1970, marked the fifth and final year of the project. This report reviews the technique involved and assesses the sex ratios and litter size of the foxes tagged during the five year study.

Study Area

The project covered a large area of north central and northeast Iowa with a couple of smaller areas in central and west central Iowa (see Figure 1). It was necessary to ear tag foxes in this large area so that a large number could be captured in a short period of time.

Method

The method of locating dens and capturing foxes has been explained in previous seminars; however, I will briefly review these methods. Active dens were located by (1) observations from roadsides and searching sections of land, (2) checking known den locations each year, (3) commission personnel contacting interested sportsmen, and (4) aerial searching by fixed wing craft and helicopter. Contact with interested outdoorsmen proved to be the most effective way of tagging many fox in a given area during a short period of time. If an aircraft and sufficient funds were available, aerial searching would be a very effective method of capturing numerous foxes in certain localities. Tagging operations began in mid-April and continued until mid-June.

Wire ferrets from 15 to 60 feet long made of spring steel were the most effective method of capturing fox pups. The ferret was cranked into a den entrance and pups were routed out and captured in long-handled dip nets. In some instances, pups were entangled in the wire and pulled out. In some dens the ferret worked very effectively, while in others, sharp bends and offshoots from main tunnelways made capture difficult and sometimes impossible.

At some dens, impossible to work with the ferret, padded No. 1 steel traps were set to catch a few of the pups present. In 1970 we attempted more trapping for pups

and also an attempt at trapping a larger number of adults was made. Trapping, however, takes time and can reduce your effectiveness in catching a large sample of fox pups. It is the only way, however, to capture a significant adult sample.

Ear tags were used to mark individual animals, with a tag being placed in each ear of the animal. Each tag was numbered and stamped "Notify Conservation Commission, Boone or Clear Lake, Iowa".

Results and Discussions

During the first year, 1966, a total of 85 fox was ear tagged with 249 in 1967; 388 in 1968; 260 in 1969, and 427 in 1970, for a grand total of 1,409 tagged foxes during the 5-year study. The sex and age breakdown by county of capture is shown in Table 1 for the spring of 1970. Previous age and sex breakdowns by county of capture are shown in earlier seminars.

Numbers of fox ear tagged do not necessarily reflect yearly population fluctuations. After 1966, the effectiveness and efficiency of our operation increased considerably. Also, our fox den contacts increased in number and in enthusiasm in locating dens. In all years, except 1966, more males than females were captured. Table 2 gives the sex ratios of fox pups captured each year. Sex ratios of fox pups are expected to be equal in the population. Our data indicates that there may be a few more male fox pups in the population than females, at least during years when large numbers of fox were captured. However, there were individual litters where a preponderance of one sex existed. As high as nine females were captured from one litter. Our data may be biased also because there were many instances where only partial litters were captured. Most trapping and kill records show a similar preponderance of males. This may not represent a true sex ratio either because most records are made in fall and winter when males are ranging more widely than females.

Litter size is difficult to assess becuase, as stated above, there were many dens where only part of the litter was captured and ear tagged. Table 3 shows the number of dens checked each year and the average number of fox captured at each den.

The actual average litter size based on dens where it was believed all fox were removed was between 5.5 and 6.0. At some active dens, no fox were captured, while at others, up to 12 pups were caught. Although it is rare when two different litters of fox use the same den, at seven different den sites we captured parts of two litters. During 1970 we captured several litters of fox with six to nine pups present.

We would like to apply nature's law of inversity here -- "When populations are low compensatory breeding occurs so that the population regains its former status". However, we have no adequate data to prove this because of the bias in our capturing technique.

Hunting and trapping accounts for about 80% of the mortality of Iowa foxes. A significant number of roadkills also occur. The amount and length of snow cover greatly affects the annual hunting mortality rate. Some unusual types of miscellaneous mortality included hay choppers and mowers, high voltage electric fences, bow and arrow, and domestic dogs killing fox pups.

A significant number of pups were killed at dens by gassing, shooting, digging up den systems and various other man-caused means. The effects of mortality and tag return rates has and will be discussed in other reports.

Knowledge of dispersal of foxes is important when dealing with epidemiology of diseases associated with foxes, disease control programs, programs designed to reduce numbers of foxes, management of foxes for economic and recreational use and evolutionary studies of foxes. Hopefully in the final analysis we will be able to better understand the fox as a predator, a fur-bearer and a game animal. We are currently planning a major scientific publication on "Foxes of the Upper Midwest" cooperatively with the University of Minnesota and the U.S. Fish and Wildlife Service.

Acknowledgement

Appreciation is extended to all fish and game personnel who assisted in the fox tagging program. Without the efforts extended by these people, as well as interested citizens, the project could not have been a success..

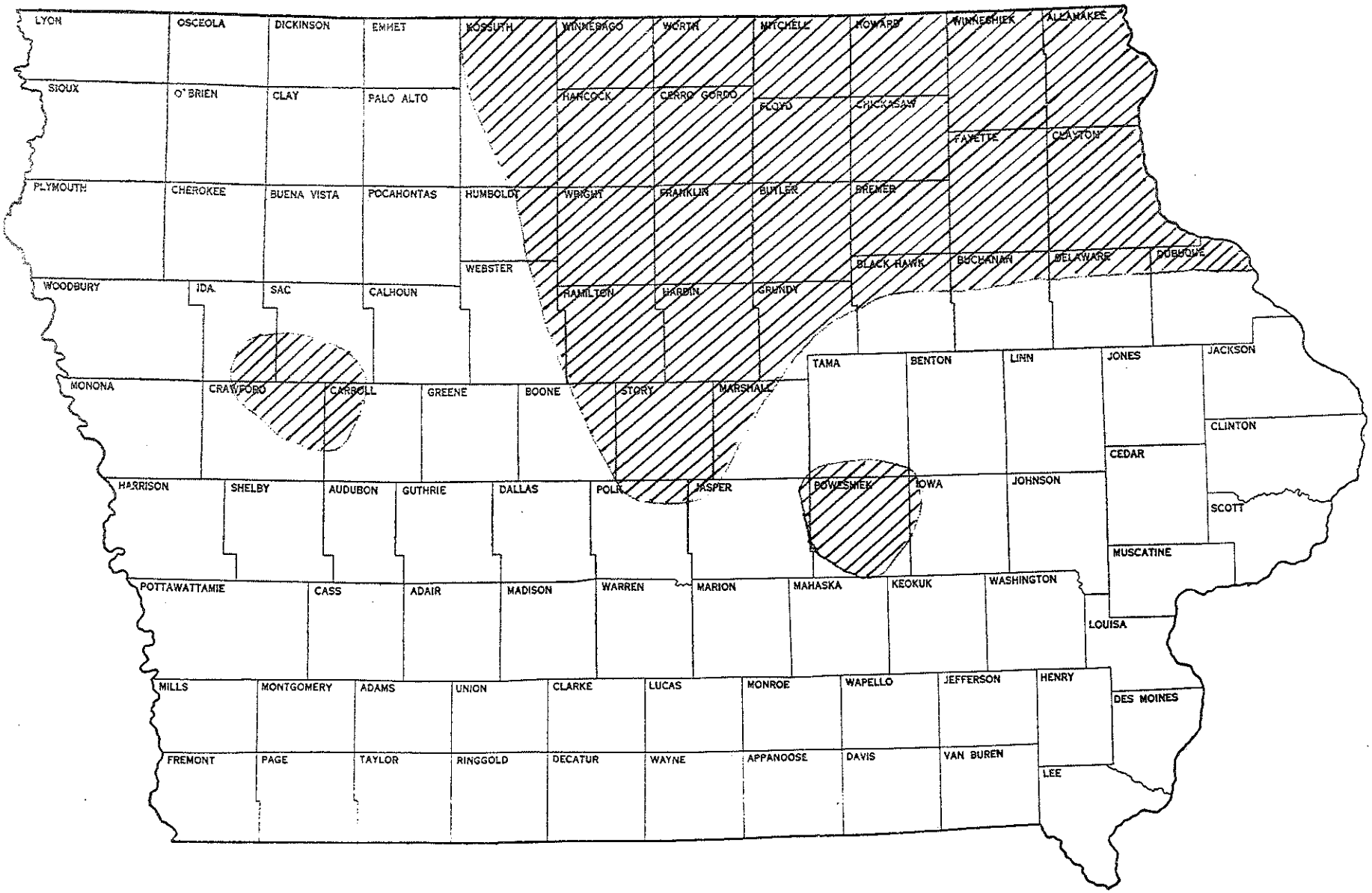


FIGURE 1. FOX TAGGING AREA

Table 1. Foxes captured and ear-tagged in Iowa, by county, 1970 (Juveniles unless otherwise indicated)*

County	Males	Females	Total
Black Hawk	5	2	7
Boone	12 + 1 AM	19 + 3 AF	35
Bremer	12	9	24
Butler	6	3	9
Cerro Gordo	12	7	19
Chickasaw	24 + 1 AM	16 + 1 AF	42
Clayton	14 + 4 AM	10 + 3 AF	31
Fayette	9	8 + 1 AF	18
Floyd	9	9	18
Franklin	17	13	30
Hamilton	1 + 1 AM	3 + 1 AF	6
Howard	20	22	42
Jasper	1	2 + 1 AF	4
Kossuth	14	15 + 1 AF	30
Mitchell	20	13	33
Poweshiek	14 + 2 AM	7 + 3 AF	26
Story	7 + 1 AM	4	12
Winnebago	8	7 + 1 AF	16
Winneshiek	10	7 + 1 AF	18
Worth	1	1	2
Wright	2	3	5
Totals	218 + 10 AM	180 + 19 AF	427

* Three adult females tagged as pups in previous years were also recaptured and released. One adult male and one adult female tagged in previous years were recaptured; however, ear slits indicated both tags had torn out of these animals ears. These fox were retagged and released.

Table 2. Yearly age ratios of juvenile fox captured - 1966-70

Year	Juvenile Males	Juvenile Females	% Juvenile Males
1966	42	42	50
1967	135	106	56
1968	207	170	55
1969	147	106	58
1970	218	180	57
TOTALS	749	604	Avg. 55

Table 3. Average catch per den at dens where one or more fox was caught

Year	No. of dens where at least one fox was caught	Total No. of fox captured	Avg. catch/den
1966	25	85	3.4
1967	70	249	3.8
1968	103	388	3.8
1969	80	260	3.3
1970	98	427	4.3
TOTALS	376	1,409	3.7

IOWA'S 1970 MAST SURVEY

Bob Sheets
Game Biologist

Iowa's mast survey, defined as a survey of nut producing trees, was begun in 1958 and has been conducted every year since. The resulting index of nut production for 14 species of trees has been one method of measuring year to year food availability with Iowa's forests. It has traditionally been used as a tool in predicting what the following year's squirrel production and harvest may be. In extensive forested lands, a mast failure in any one year can cause delayed breeding with a subsequent above normal harvest of lactating females in the fall. Varying degrees of winter starvation would accompany a mast failure causing smaller litters of squirrels in the spring. Therefore, it has the potential of retarding squirrel hunter success.

The general consensus, however, is that in Iowa fox squirrels are independent of mast due to the availability of grains and corn. However, Table 1 shows a surprising relation between mast and hunter success. A positive correlation exists in all but one comparison; that between the 1966 mast survey and the following year's hunter kill. If it were possible to separate the kill data according to fox and gray squirrels, less of a correlation may be found with fox squirrels and more with gray squirrels.

One stabilizing factor influencing our mast survey is the existence of a mixed community of Black Oaks and White Oaks in Iowa. Black Oaks including Pin Oak, Red Oak, Shingle Oak, Black Jack Oak, and Black Oak itself, set their acorns 15 months prior to filling and ripening of the nuts. This means acorns appearing in the axils of new leaf shoots in May will not ripen until one year after the following September. On the other hand, the White Oak group including White Oak, Swamp White Oak, Post Oak, and Burr Oak producing new acorn buds in May will yield ripe acorns four months later. Consequently, severe weather conditions retarding acorn growth of one or the other oak group in any one year will not retard the growth of the other species acorns.

Although apparent reliability is occurring in the present mast survey, some standard guidelines need to be established. These guidelines will be formulated and sent to all cooperators between now and the upcoming year's mast survey. In the meantime, there are several points that may act as helpful suggestions. Optimum fruiting or acorn production has been found on Black Oaks and White Oaks having a diameter of 6-8" or more. The mast survey is designed to measure fruiting abundance and care should be used in selecting the most productive stand of timber. It would also be advisable to check the selected sites prior to, during, and after peak mast production is reached. This will allow the observer to compare notes and relay the results indicating maximum mast.

Squirrels begin cutting acorns, walnuts and hickory nuts by mid-August, and much of a local mast crop can be cached by mid-September. Red oak trees found to be producing a medium mast yield on August 15 were found without acorns on September 10.

Cuttings of acorns and branch tips have been the only remnants beneath the trees, indicating squirrels had simply "cleaned house" before the second check was made. It is quite likely that a late August deadline will be placed on the return of future surveys.

Table 2 has been inserted to show a two-year comparison between District Foresters' and United Game Managers' mast estimates. Although slight differences exist, both appear uniform in lending reliable trend information. With the establishment of survey guidelines, it will be interesting to see if the estimates from the two groups will begin to approach each other. It will be one method of checking the effectiveness of a more standardized technique.

Table 1. Mast production compared to squirrels harvested the following year

Year	Mast Index	Statewide Bag	Bag per Gun Hour
1963	2.2		
1964	1.8	1,440,576	.65
1965	2.4	1,111,290	.60
1966	1.9	1,236,400	.55
1967	1.9	1,370,250	.62
1968	1.5	1,196,810	.58
1969	2.0	1,014,940	.47
1970	1.6	1,164,030	.52
	1.9	Harvest not completed	

Table 2. Comparison of mast survey estimates made by District Foresters and Unit Game Managers

Species	1969 Statewide Index	1969 Unit Managers	1969 District Foresters	1970 Statewide Index	1970 Unit Managers	1970 District Foresters
Black Walnut	1.77	1.84	1.80	2.00	2.00	2.00
Butternut	1.69	1.83	1.57	1.55	1.66	1.80
Shagbark hickory	2.20	2.20	2.20	1.80	1.75	1.90
Bitternut hickory	2.16	2.00	2.22	1.50	1.28	1.60
White oak	1.39	1.66	1.20	2.45	2.71	2.27
Burr Oak	1.56	1.80	1.45	2.43	2.45	2.00
Swamp white oak	1.25	1.00	1.33	1.60	3.00	1.25
N. red Oak	1.52	1.75	1.45	2.19	2.40	2.00
Black oak	1.57	1.66	1.50	2.12	2.16	2.11
Pin oak	1.64	1.75	1.50	2.08	2.14	2.00
Blackjack oak	2.00		2.00	2.00		2.00
Shingle oak	1.40		1.00	1.66		1.66
Post oak	1.00	1.00	1.00	2.00		2.00
Chinkapin oak	1.37	2.00	1.50	2.00	2.00	2.00
Average Statewide Index	1.625	1.70	1.55	1.955	2.14	1.89